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PREFACE

*We are delighted to publish our book entitled "**Ecology Research (Volume II)".** This book is the compilation of esteemed articles of acknowledged experts in the fields of ecology providing a sufficient depth of the subject to satisfy the need of a level which will be comprehensive and interesting. It is an assemblage of variety of information about advances and developments in ecology. With its application oriented and interdisciplinary approach, we hope that the students, teachers, researchers, scientists and policy makers will find this book much more useful.*

The articles in the book have been contributed by eminent scientists, academicians. Our special thanks and appreciation goes to experts and research workers whose contributions have enriched this book. We thank our publisher Bhumi Publishing, India for compilation of such nice data in the form of this book.

Finally, we will always remain a debtor to all our well-wishers for their blessings, without which this book would not have come into existence.

- Editorial Team

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A STEP TO ATTAIN SUSTAINABLE DEVELOPMENT IN CROP PRODUCTION AND SOIL HEALTH

Anupama Prabhakarrao Pathak[1]*, Mukundraj Govindrao Rathod[2], Shubham Ashok Rakhe[1], Neha Uttamrao Bhure[1], Rajashri Satishrao Borade[1] and Poonam Sutrappa Kamalapure[1]

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Abstract:

A soil conditioner is an eco-friendly material added to soil to improve its overall condition, especially for plant growth and health. Conventional and recent types of soil conditioners are used based on the type of soil and the cultivar species. In present investigation we have put forth a step towards sustainable growth of selected crop by improving soil health. This has been achieved by using diazotrophic *Azotobacter* sp. NFMA1 and phosphate solubilizing *Bacillus* sp. PA1 as bioinoculants, which were isolated from rhizospheric soil sample of *Saccharum officinarum*. Moreover we have developed vermicompost by using *Eisenia foetida* worm, kitchen vegetable waste and agricultural residues and tested as soil conditioner against the selected cultivars. Among three different soil conditioners tested, vermicompost was found highest potent than *Bacillus* sp. PA1 and *Azotobacter* NFMA1 bioinoculants on 12th day cultivation of *Triticum aestivum* (Wheat) and *Cicer arietinum* (Gram). Increment in shoot length of all cultivars in vermicompost containing pots was monitored only up to 12th day; however growth of *Triticum aestivum* and *Cicer arietinum* was monitored up to 16th day in response to *Bacillus* sp. PA1 and *Azotobacter* NFMA1 bioinoculants. Potency of phosphate solubilizing *Bacillus* sp. PA1 bioinoculant was found remarkably higher than diazotrophic *Azotobacter* sp. NFMA1 against *Triticum aestivum* and *Cicer arietinum* on 16th day of cultivation. In conclusion, *Azotobacter* sp. NFMA1 and *Bacillus* sp. PA1 bioinoculants and the vermicompost formulated by us were found as potentially beneficial soil conditioners.

Keywords: Diazotrophs, PSB, Soil conditioner, Pikovskaya's agar, Vermicompost, Vermiwash

Introduction:

The term soil conditioning is used to indicate effects on soil structure. Soil conditioning in agriculture implies the formation and the stabilization of aggregates which allow appropriate aeration and draining in the root zone, and hence can give rise to improved crop yields.[1] A soil conditioner is an eco-friendly material added to soil to improve its overall condition, especially for plant growth and health. It is also called a soil amendment. Soil conditioner plays an important role to increase strength of soil.[2] At present, there is a wide range of eco-technological tools used to restore semiarid environments that make it possible to improve (micro) site conditions, resource availability and the capacity of plants to endure stress. One of these tools is soil conditioners, i.e. products mixed with the soil in the planting pit to improve the soil chemical and/or physical properties at micro-site level for improving early seedling performance.[3]

Conventional types of soil conditioners:

Type of conditioner is dependent on current soil composition and the type of plant to be cultivated on selected soil. Soil conditioners can be synthetic or naturally occurring and organic or inorganic material. Some examples of soil conditioner are peat, coffee grounds, compost tea, fertilizers, lime, and vermiculite and sphagnum moss. Lime is used to make soil less acidic. Gypsum is used to release nutrients and improve soil structure. Peat, clay and vermiculite are used to increase water holding capacity of soil. Compost (fertilizer) is used to add depleted plant nutrients in soil. Mulches are used for retaining moisture and nutrients so that plants remain healthy.[2]

Recent types of soil conditioners:

Sewage Sludge is used as soil conditioner and nutrient source.[4] Nano-submicron mineral-based soil conditioner is used for Cd inhibition and pH improvement.[5] Vegetable tannery biosolids are used as an organic biofertilizer and soil conditioner.[6] A sawdust-derived soil conditioner is used to promote plant growth and improvement in water-holding capacity of different types of soils.[7] A mineral soil conditioner (MSC) composed of activated potash feldspar, gypsum, and calcium carbonate is used for plant growth and acidic soil amelioration.[8] Bitumenous emulsions are used as soil conditioners for various soil textural classes.[9] The soil conditioners made-up from straw, sewage sludge, and polymer (cross linked polyacrylamide + perlite) are used for water permeability and water-holding capacity of light chestnut soils.[10] Soil conditioners from food waste are prepared by short-duration hydrothermal fermentation (SHF) method for arable soils.[11] A species of brown algae i.e. *Sargassum johnstonii* is used as a soil conditioner and fertilizer.[12] Oyster shell soil conditioner is used to enhance growth of soil and rhizospheric microorganisms.[13] A

superabsorbent hydrogel composite based on a starch-grafted-poly (sodium acrylate) matrix filled with husk rice ash (RHA) is used as a soil conditioner to enhance the melon seedling growth.[14]

Functions of soil conditioners:

Soil conditioners are used for increment in water holding capacity of soil and availability of water to plants, improvement in soil structure and aeration, alkali soil reclamation, development of better root, improved tile drainage effectiveness, better chemical incorporation, release of locked nutrients and maximum yield and its best quality. Soil conditioners are added to improve the soil quality, to rebuild soils which have been damaged by improper management, to make poor soils more usable, and to maintain soils in peak condition. Excess use of soil conditioner should be avoided that can make some plants sick, and it also generates runoff into neighboring waterways, which is harmful for the environment.[2]

In present investigation we propose a comprehensive solution to improve overall fertility of soil by using selected prokaryotic and eukaryotic soil conditioners. We performed pot experiments by using diazotrophic bacteria, phosphate solubilizing bacteria, and vermicompost made by *Eisenia foetida* and recorded noteworthy shoot development in selected cultivars i.e. *Cicer arietinum*, *Triticum aestivum*, *Sesamum indicum* and *Glycine max*.

Materials and Methods:

Part A- Development of soil conditioners:

Vermicompost development using agricultural residue and kitchen waste:

Plastic tub of 58×26×24 cm size having 4 drainage holes at equidistance position was selected for vermicomposting. 5 kg of garden soil was added at the bottom of tub and moistened with tap water. Second layer was made-up of vegetable waste, soybean residues and cow dung. This layer was covered with soil. Approximately 100-120 epizoic red earthworms (*Eisenia foetida*) were introduced in the composting tub. These worms had average body length and weight as 3-10 cm and 0.4-0.6 gm respectively. All the worms were covered with a layer of soil followed by a mat of dry-leaves of plants. The composting tub was covered with green net and protected from direct entry of sunlight. The water was sprinkled thrice in a week and all layers were mixed properly. After 20 days, compost samples were taken out to carry out pot experiments.[15-23]

Enrichment and isolation of diazotrophs and phosphate solubilizing bacteria in selective media:

Sugarcane rhizospheric soil samples were collected from the agricultural farm of Kaleshwar, Nanded. 1 gm of composite soil sample was added in each flask containing 100 mL of nitrogen free mannitol broth and Pikovskaya's broth (selective media). All flasks were incubated at 30 ^{o}C temperature under mild agitating condition for 7 days in an orbital shaking incubator. The enrichment technique for diazotrophs was based on their ability of to grow by fixing nitrogen aerobically and to use organic substrate i.e. mannitol as an energy source in nitrogen free mannitol broth. Aliquots containing 100 µL of enriched culture from each flask were spread individually on nitrogen free mannitol agar and Pikovskaya's agar plates and incubated at 30^{o}C for 24-72 h in a bacteriological incubator. Selected morphologically distinct pure colonies from each medium were inoculated individually in nitrogen free mannitol broth and Pikovskaya's broth, incubated at 30^{o}C for 48-72 h and subjected for their culture dependent characterization and pot experiments.[24-26] Morphological, microscopic, biochemical and physiological characters of selected isolates were studied as per the methods described in Bergey's manual of systematic bacteriology and our some of the previously published papers.[27-42]

Part B- Pot trials:

Pot trial using vermicompost:

The seeds of *Cicer arietinum* (Gram), *Triticum aestivum* (Wheat), *Sesamum indicum* (Sesame) and *Glycine max* (Soybean) were used for pot trial experiments. 4 pots were taken for each type of seed. Out of 4 pots, 2 were filled with garden soil and assigned as control and remaining 2 were filled with equi-proportion mixture of vermicompost and garden soil and assigned for testing proficiency of vermicompost. Seven healthy seeds were sowed at equidistance in each pot and growth of seedlings was monitored at a same time up to 12 days. During the period of seedling cultivation, equal volume of vermiwash was added in compost pots whereas distilled water was added in control pots. The length of all seedlings was measured by thread method. Growth of seedlings in compost pots was compared with growth in control pots. Average shoot length of cultivar in control pot was assumed as 100 % and increment percentage in shoot growth of cultivars from vermicompost containing pot was calculated.[43]

Pot trials for testing proficiency of selected diazotrophic and PSB cultures:

The seeds of *Triticum aestivum* (Wheat) and *Glycine max* (Soybean) were used in this pot trial experiments. 6 pots were taken for each type of seed. All pots were filled with equal weight of garden soil. Out of 6 pots, 2 were assigned as control, another 2 pots

assigned for testing proficiency of enriched culture of diazotrophs and remaining 2 assigned for testing proficiency of enriched culture of PSB. Five healthy seeds were sowed at equidistance in each pot. During the period of seedling cultivation, 10 mL of diluted cell suspension (10^8-10^9 cfu/mL) was added daily in the form of soil drenching in working pots whereas distilled water was added in control pots. All pots were exposed everyday to sunlight for 8 h and kept in dark for 16 h. Seedlings were monitored for increment in their shoot length from 4^{th} to 16^{th} day. The length of all seedlings was measured by thread method. Growth of all type of seedlings in working pots was compared with growth in control pots. [44]

Statistical analysis:

Statistical analyses i.e. arithmetic mean, standard deviation and graphical representation of data were computed in MS-Excel 2010 version [47].

Results and discussion:

Part A:

Isolation and Culture dependent characterization of selected diazotroph and PSB isolates:

Total 129 and 87 colonies were appeared on nitrogen free mannitol agar and Pikovskaya's agar plates after 72 h of incubation period. Single colony from nitrogen free mannitol agar and Pikovskaya's agar medium was selected and designated by alphanumerical code as NFMA1 and PA1 respectively. NFMA1 and PA1 were identified as *Azotobaccter* sp. and *Bacillus* sp. respectively, based on their morphological, microscopic, biochemical and physiological characteristics as displayed in Table 1.

Part B: Pot trials:

Proficiency of vermicompost:

Average length of shoots after germination of *Cicer arietinum* (Gram), *Triticum aestivum* (Wheat), *Sesamum indicum* (Sesame) and *Glycine max* (Soybean) seeds in vermicompost containing pot and control pot are given in Table 2. The highest 61.69 % increment in shoot length of *Triticum aestivum* (Wheat) was recorded followed 54.98 % in *Sesamum indicum* (Sesame), 6.39% in *Glycine max* (Soybean) and 3.80% in *Cicer arietinum* (Gram) (Fig. 1 and Fig. 2).

Proficiency of selected diazotrophs and PSB cultures in pot trial:

Cicer arietinum (Gram) and *Triticum aestivum* (Wheat) seeds tested by drenching with *Azotobacter* sp. NFMA1 bioinoculant have shown distinguishable increment in shoot length when compared with control (Table 3). Shoot length of *Triticum aestivum* (Wheat)

and *Cicer arietinum* (Gram) was increased by 63.02 and 23.74 % respectively in response to *Azotobacter* sp. NFMA1 bioinoculant on 16th day (Figure 3).

Table 1: Characterization of bacterial isolates appeared on nitrogen free mannitol agar and Pikovskaya's agar and their comparison with standard reference type of strain

Isolate and Reference species → Character↓	NFMA1	*Azotobacter chroococcum* R.L.Starkey's strain 43, ATCC 9043, DSM 2286, WR-88.	PA1	Bacillus subtilis NRRL B-23049, DSM 15029, LMG 19156, KCTC 3705
Colony characteristics				
Shape	Round	Round	Round	Round
Size	2 mm	1-4 mm	3 mm	2-4 mm
Margin	Entire	Entire,Irregular	Undulate	undulate to fimbriate
Pigmentation	-	brown-black nondiffusible pigment in aged culture	white	varying from creamy, yellow, orange, pink and red to brown or black
Elevation	Convex	Convex	Convex	convex
Opacity	Opaque	Opaque	Opaque	Opaque
Consistency	Sticky	Sticky	Moist	Moist or dry
Surface	Smooth, Glistening	Glistening	Smooth	Dull, wrinkled
Microscopic character				
Gram-stain reaction	-	-	+	+
Cell shape	ellipsoid	blunt rods to ellipsoid forms	Slender rod	Slender rod
Cell size	nd	1.6-2.5 µm in diameter and 3-5 µm in length	nd	0.7-0.8 µm in diameter and 2-3 µm in length
Sporulation	-	-	+	+
Cyst formation	+	+	-	na
Cellular motility	+	+	+	+
Peritrichous flagella	nd	+	nd	na
Utilization of sole carbon source				
Fructose	nd	+	nd	+
Glucose	+	+	+	+
Acetate	nd	+	nd	na
Pyruvate	nd	+	nd	na
Fumarate	nd	+	nd	na

Malate	nd	+	nd	na
Succinate	nd	+	nd	na
α-oxoglutarate	nd	+	nd	-
Lactate	nd	+	nd	na
Gluconate	nd	+	nd	na
Acetyl methylcarbinol	nd	+	nd	na
Sucrose	+	+	+	+
Propionate	nd	+	nd	-
β-Phenylpropionate	nd	d	nd	na
Butyrate	nd	+	nd	na
Glutarate	nd	-	nd	na
β-hydroxybutyrate	nd	d	nd	na
Benzoate	nd	d	nd	na
Trehalose	nd	d	nd	na
Melibiose	nd	+	nd	d
Maltose	nd	+	nd	+
Raffinose	nd	+	nd	+
Propanol	nd	d	nd	na
Butanol	nd	+	nd	na
Glycerol	nd	d	nd	+
Mannitol	++	+	nd	na
Sorbitol	nd	+	nd	+
Citrate	nd	na	nd	+
Enzyme profile				
peroxidase	+	+	+	+
urease	nd	+	nd	na
oxidase	nd	+	+	v
Amylase	nd	+	+	+
Casein	nd	na	nd	+
Gelatin	nd	na	nd	+
Some other biochemical and physiological tests				
Nitrogen fixation at pH				
5.0-5.5	nd	-	nd	na
6.0	nd	-	nd	na
6.5-9.5	nd	+	nd	na
10.0	nd	+	nd	na
VP test	nd	na	nd	+
Production of H_2S from				
Thiosulphate	nd	d	nd	na
Cysteine	nd	-	nd	na
Growth at temperature				
9°C	nd	-	nd	d
14 °C	nd	d	nd	d
18 °C	nd	+	nd	+
32 °C	++	+	+	+
37 °C	+	d	+	+
Growth at pH				
6	+	+	+	+
7	+	+	+	+

8	nd	+	nd	+
Diffusible exopolysaccharide production	nd	+	nd	na
*Scientific name proposed based on nearest reference species	*Proposed as *Azotobacter* sp.	*Azotobacter chroococcum* (Reference species) [27]	*Proposed as *Bacillus* sp.	Bacillus subtilis (Reference species) [28]

Abbreviations: - negative, w+ weakly positive, + positive, ++ highly positive, nd test not determined, d different strains give different reactions, na data not available, v variable, * Identification is based on Bergey's manual of systematic bacteriology (Vol. II and III).

Table 2: Assessing growth of *Cicer arietinum* (Gram), *Triticum aestivum* (Wheat), *Sesamum indicum* (Sesame) and *Glycine max* (Soybean) seedlings in presence of vermicompost soil conditioner

Shoot length of cultivars with its control (cm)↓	4th Day	5th Day	6th Day	7th Day	8th Day	10th Day	11th Day	12th Day
Control	0.94±1.29	2.03±1.67	3.10±1.93	3.26±1.06	4.64±2.51	5.61±2.89	6.51±3.20	7.89±2.02
Cicer arietinum	1.62±1.39	2.19±1.79	3.36±1.75	3.87±2.13	5.34±2.65	5.83±3.30	6.74±3.14	8.19±2.91
Control	0.9±1.11	1.8±1.15	2.6±2.09	4.5±2.23	6.4±2.56	6.9±2.05	7.7±2.11	8.9±2.36
Triticum aestivum	6.74±2.17	7.96± 1.94	8.51±2.38	9.26±2.41	10.13±2.55	10.89±2.03	14.19±1.33	14.39±1.77
Control	2.50±0.69	2.33±0.75	2.74±0.81	2.79±0.68	2.76±0.84	2.89±0.75	2.89±0.64	3.11±0.72
Sesamum indicum	4.07±0.57	4.36±0.62	4.31±0.57	4.41±0.59	4.47±0.59	4.58±0.57	4.69±0.56	4.82±0.63
Control	0.80±0.78	1.45±1.38	2.08±1.37	3.09±1.94	4.37±2.58	5.11±3.12	5.55±3.42	6.57±3.59
Glycine max	1.28±1.54	0.90±1.54	1.75±2.15	4.36±2.73	4.31±2.68	5.76±3.48	6.36±3.47	6.99±3.70

(n=14)

Table 3: Evaluation shoot length of *Cicer arietinum* (Gram) and *Triticum aestivum* (Wheat) in response to *Azotobacter* sp. NFMA1 bioinoculant

Shoot length (cm) of cultivars measured on the corresponding day ↓	*Cicer arietinum* (Gram)		*Triticum aestivum* (Wheat)	
	Test	Control	Test	Control
4th Day	0.45 ±0.30	0.20 ±0.23	1.00±0.28	0.35 ±0.07
5th Day	0.88 ±0.50	0.63 ±0.44	1.85±0.92	0.75 ±0.35
6th Day	1.50 ±0.70	1.08 ±0.74	2.90±1.56	1.15 ±0.35
7th Day	2.28 ±0.96	1.75 ±0.93	3.75±1.77	1.75 ±0.35
8th Day	2.98 ±1.01	2.33 ±1.07	4.80±1.41	2.55 ±0.49
9th Day	3.75 ±1.00	2.95 ±1.17	5.75±1.77	3.40 ±0.57
10th Day	4.58 ±1.38	3.53 ±1.27	4.75±5.73	4.10 ±0.42
11th Day	5.53 ±1.72	4.28 ±1.38	9.35±0.92	4.85 ±0.64
12th Day	6.50 ±1.98	4.98 ±1.37	10.55±0.92	5.40 ±1.13
13th Day	7.45 ±2.14	5.73 ±1.50	5.90±6.93	6.50 ±1.41
14th Day	8.23 ±2.40	6.55 ±1.62	13.45±1.34	7.45 ±1.20
15th Day	9.28 ±2.69	7.58 ±1.72	14.85±1.34	8.20 ±1.41
16th Day	10.58 ±2.69	8.55 ±1.80	15.65±1.91	9.60 ±1.13

(n=3)

Table 4: Assessing growth of *Cicer arietinum* (Gram) and *Triticum aestivum* (Wheat) drenched with *Bacillus* sp. PA1 bioinoculant (PSB)

Shoot length (cm) of cultivars measured on the corresponding day ↓	*Cicer arietinum* (Gram)		*Triticum aestivum* (Wheat)	
	Test	Control	Test	Control
4th Day	0.50 ±0.36	0.30 ±0.10	1.17 ±1.10	0.30 ±0.10
5th Day	1.20 ±0.20	0.57 ±0.31	2.70 ±2.15	0.60 ±0.36
6th Day	1.80 ±0.53	1.70 ±0.70	3.50 ±2.55	0.97 ±0.81
7th Day	3.07 ±0.23	2.60 ±0.87	4.50 ±2.78	1.07 ±0.81
8th Day	3.57 ±0.49	3.47 ±0.76	7.93 ±0.93	1.43 ±1.18
9th Day	4.30 ±0.61	3.90 ±0.52	9.43 ±0.93	1.73 ±1.62
10th Day	5.27 ±1.18	4.40 ±0.40	10.47 ±0.55	2.13 ±1.79
11th Day	6.13 ±1.69	5.33 ±0.55	12.73 ±1.21	2.73 ±2.48
12th Day	7.20 ±1.92	5.80 ±0.26	13.90 ±1.90	2.93 ±2.48
13th Day	8.10 ±2.17	6.70 ±0.26	14.93 ±2.00	3.07 ±2.55
14th Day	9.07 ±2.57	7.50 ±0.62	17.00 ±2.84	3.43 ±2.93
15th Day	10.33 ±2.04	7.90 ±0.61	17.23 ±2.85	3.73 ±2.84
16th Day	11.80 ±2.52	8.53 ±0.65	17.40 ±2.82	3.97 ±2.74

(n=3)

Similarly, another replicate of these cultivars have shown luxurious growth in response to *Bacillus* sp. PA1 bioinoculant (Table 4). Shoot length of *Triticum aestivum* (Wheat) and *Cicer arietinum* (Gram) was increased by 338.28% and 38.33% respectively in response to *Bacillus* sp. PA1 bioinoculant on 16th day (Figure 4). Potency of *Bacillus* sp. PA1

bioinoculant was found remarkably higher than *Azotobacter* sp. NFMA1 against *Triticum aestivum* and *Cicer arietinum.*

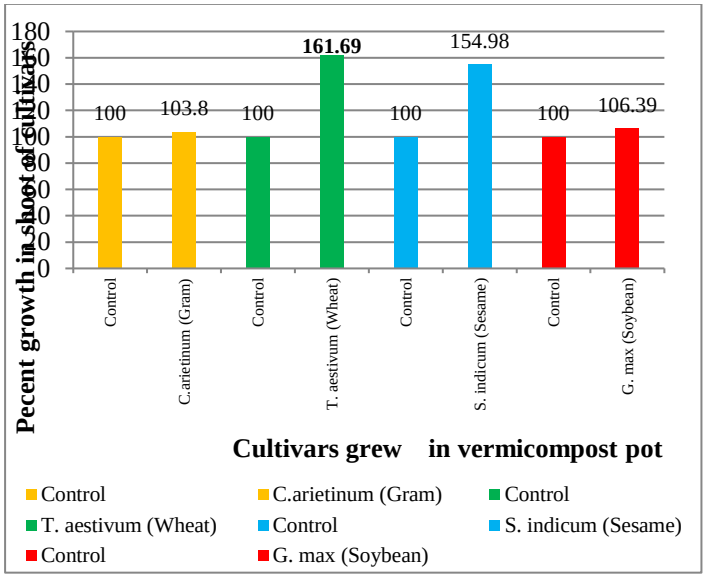


Figure 1: Percentage of shoot length of cultivars from vermicompost containing pot and control pot recorded on 12th day of cultivation (100 % shoot length assumed in individually maintained control pots for each type of cultivar) (n=14)

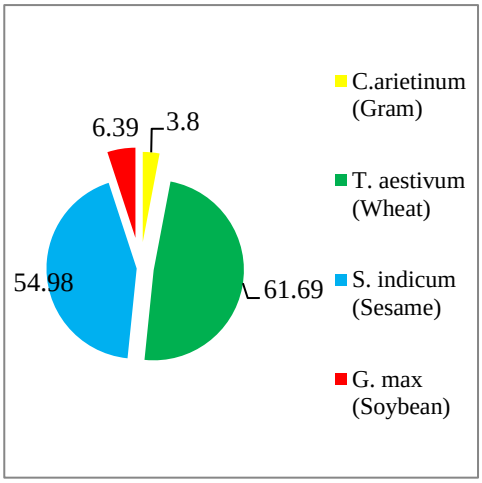


Figure 2: Percent increment in shoot length of cultivars from vermicompost containing pot recorded on 12th day of cultivation

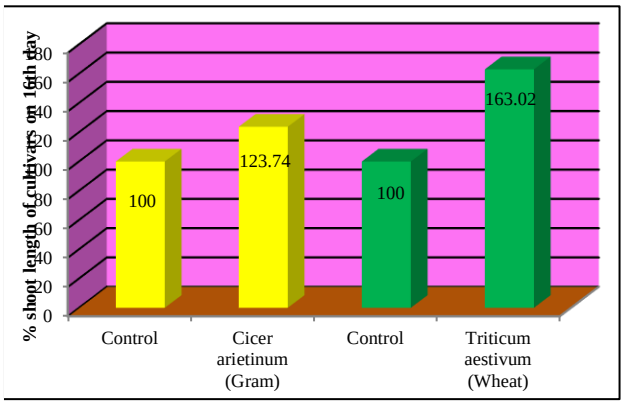


Figure 3: Percentage of shoot length in Cicer arietinum (Gram) and Triticum aestivum (Wheat) in response to Azotobacter sp. NFMA1 bioinoculant recorded on 16th day of cultivation (100 % shoot length assumed in control).

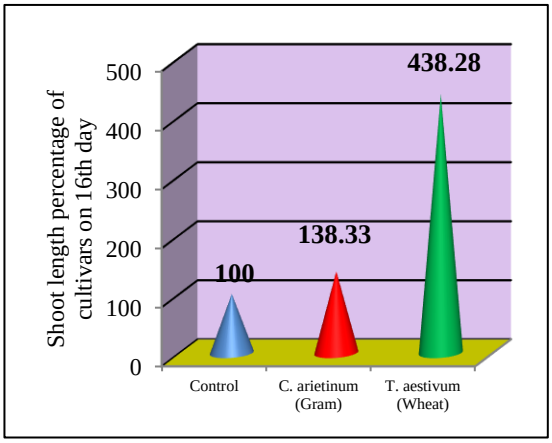
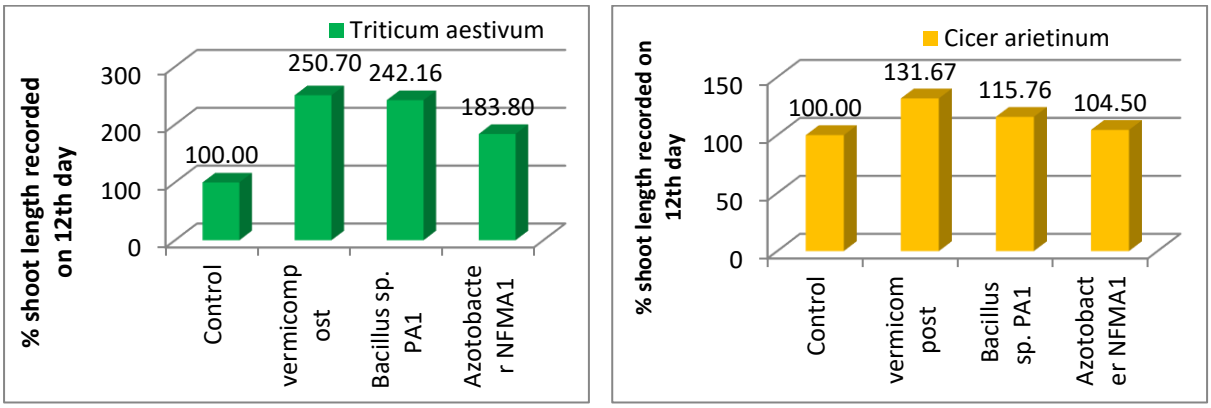
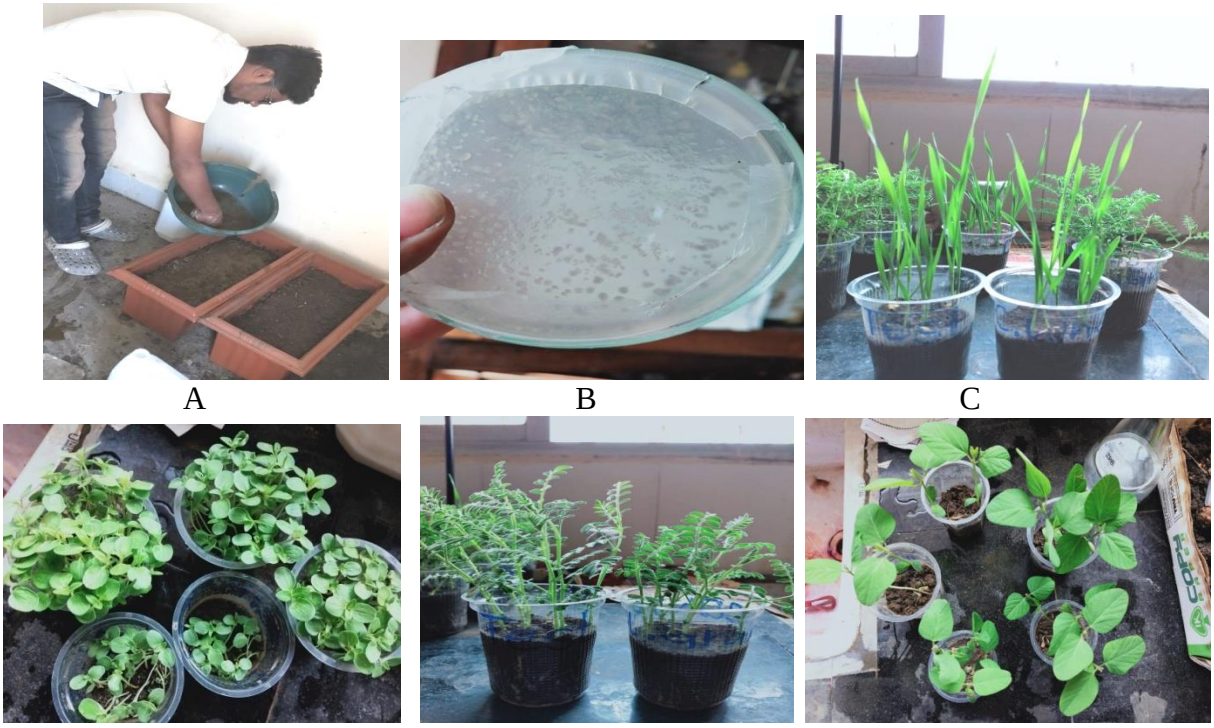


Figure 4: Percentage of shoot length of *Cicer arietinum* (Gram) and *Triticum aestivum* (Wheat) in response to *Bacillus* sp.PA1 bioinoculant recorded on 16th day of cultivation (100 % shoot length assumed in control).



A B

Figure 5 (A and B): Effect of *Bacillus* sp. PA1, *Azotobacter* NFMA1 (as bioinoculant) and vermicompost on shoot growth of *Triticum aestivum* and *Cicer arietinum* recorded on 12th day of cultivation



A B C

D E F

Figure 6 (A to F): A- Vermicompost formulation, B-Colonies of *Azotobacter* sp. NFMA1, C-Effect of *Azotobacter* sp. NFMA bioinoculant on *Triticum aestivum* (control at right), D-Growth of *Sesamum indicum* in vermicompost containing pot (down 2 pots are control), E- Effect of *Bacillus* sp. PA1 on growth of *Cicer arietinum* (control at right), F-Cultivation of *Glycine max* in compost containing pots

Comparing proficiency of vermicompost, Bacillus sp. PA1 and Azotobacter sp. NFMA1:

Among three different soil conditioners tested, vermicompost was found highest effective than *Bacillus* sp. PA1 and *Azotobacter* NFMA1 bioinoculants on 12th day

cultivation of *Triticum aestivum* (Wheat) and *Cicer arietinum* (Gram) as illustrated in Figure 5 (A and B). *Triticum aestivum* (Wheat) and *Cicer arietinum* (Gram) have shown 2.51 and 1.32 fold increment in shoot length after cultivation in vermicompost, 2.42 and 1.16 fold increment in shoot length in response to *Bacillus* sp. PA1, and 1.84 and 1.05 fold increment in shoot length in response to *Azotobacter* NFMA1 bioinoculants respectively. Selected photographs of pot experiments and vermicomposting are displayed in Figure 6.

In order to develop a soil conditioner, there is a need to develop simple, inexpensive and quick procedures with repeatable and reliable results.[45] In this regard, the procedure followed by us was easy, inexpensive and eco-friendly. Such as an *in vitro* soil conditioner development procedure (formulation of diazotrophic and PSB bioinoculants and vermicomposting) and the combinations of which may provide rapid and repeatable results. Vermicompost formulated by us was found an excellent growth promoter for selected cultivars and would be used as sustainable alternative to chemical fertilizers. PSB play a significant role by solubilizing inorganic phosphorus from soil and make available to plants.[44] The soil inhabiting *Azotobacter* sp. produces thiomin, riboflavin, nicotin, indol aacetic acid, siderophore and giberalin. *Azotobacter* sp. and other non symbiotic nitrogen fixing bacteria are known to fix an average 20 kg nitrogen/hectare/year. Such types of soil conditioners promote luxurious growth of crops and increase yield.[46]

Conclusions:

The diazotrophic *Azotobacter* sp. NFMA1 and phosphate solubilizing *Bacillus* sp. PA1 were isolated from rhizospheric soil sample of *Saccharum officinarum*. The vermicompost was formulated by using kitchen waste and agricultural residues. In pot trial experiments, *Azotobacter* sp. NFMA1, *Bacillus* sp. PA1 and vermicompost have shown excellent increment in shoot length of *Cicer arietinum*, *Triticum aestivum*, *Sesamum indicum* and *Glycine max*. Selected diazotrophic and PSB isolates and the vermicompost formulated by us were found as potentially beneficial soil conditioners and should be tested more in field conditions. The isolates reported by us may be used as biofertilizers inoculants at large scale for maximum crop yield.

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Abbreviation: PSB- Phosphate solubilizing bacteria

Conflict of interest: The authors declare there is no conflict of interest.

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STUDIES ON CORRELATION BETWEEN SOIL PHYSICOCHEMICAL PROPERTIES AND GROWTH OF AZOTOBACTER SP FROM LOW FERTILE SOILS OF NANDED

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Abstract:

In the present study the physico-chemical analysis of 30 low fertile soil samples from Nanded district of Marathwada region was carried out. The soil parameters including soil texture, organic carbon and organic matter content, water holding capacity, pH, electrical conductance, available phosphorus, calcium and potassium content and metal s including cadmium, mercury, lead, nickel, chromium, zinc were determined in consideration of the soil's suitability for the growth of Azotobacter species. The parameters were compared with a good quality fertile soil from Nanded. Correlation studies between population of Azotobacter sp and physicochemical factors were carried out to identify crucial factors affecting growth of Azotobacter species. The physicochemical parameters differed considerably from the control soil in respect to high pH and electrical conductance, low carbon and phosphorus content, varied texture and high amounts of heavy metal ions. The count for Azotobacter population was also very low in contrast to control soil. Organic matter content, pH, available phosphorus were found to exert positive effect on growth of Azotobacter species whereas the high concentrations of cadmium, lead, mercury, electrical conductance showed negative correlations with Azotobacter growth.

Keywords: Organic Matter Content, Water Holding Capacity, heavy metals, Azotobacter, low fertile.

Introduction:

The nitrogen fixation by Azotobacter sp assumes a great significance in natural and agricultural system in view of improving soil fertility and crop yield. Azotobacter sp represents main group of free living nitrogen fixing bacteria that are widely distributed in

soil and associated with plants and aquatic system. They show beneficial effect on plant growth and yield due to enhanced fixed nitrogen content in the soil. Many agronomically important crops as cereals, wheat, rice, maize, sorghum, potato, sugarbeet, onion, tomato etc are benefitted due to Azotobacter inoculation[1 – 4].

The number of Azotobacter sp in various parts of the world is usually below 10^4/g soil. The population of Azotobacter sp and their plant growth promoting activities in soil depend on influence of plants, soil microbial interactions and physicochemical properties of soil. The population and activity of Azotobacter are generally affected by a number of physicochemical characteristics includes pH[5], amount of organic matter[6], available phosphorus content, soil aeration and moisture content of soil.

The soil that supports the optimum activity of Azotobacter should possess a good soil structure, sufficient minerals for their nutrition, high organic matter content and neutral to slightly alkaline pH and should not be suppressive. The increase in *Azotobacter* count has been found with increasing carbon content in the soil [7]. The knowledge of individual physicochemical factors affection Azotobacter is important for its optimum activity. With this knowledge it might be possible to manipulate these factors to encourage the growth of Azotobacter sp. Therefore in the present study low fertile soils of Nanded region are analyzed for different physicochemical properties and their correlation with population of Azotobacter sp was studied to understand crucial factors affecting the survival of Azotobacter sp.

Materials and Methods:

Collection of soil samples:

The low fertile soil sites were selected from different regions of Nanded, Marathwada. From each location 25 random soil samples were collected at a depth of 15 cm using auger. The samples were thoroughly mixed together in a large container. After removing recognizable stones and debris, the composite soil samples were air dried and sieved through a 2mm mesh sieve and kept in sealed plastic bags at 4^0C till processed. A total 30 samples were collected from different regions of Nanded. A fertile soil sample was collected from sugarcane field of Nanded and used as control sample. The samples were subjected to physical and chemical analysis.

Physicochemical Analysis of soil samples:

The collected samples were analyzed for major Physical and Chemical soil quality parameters as per the standard criteria and methods explained by Jackson[8]. The parameters analyzed includes determination of soil texture, water holding capacity, PH,

Electrical Conductivity (EC), Organic Carbon (OC), organic matter, Calcium and Potassium content, Soil phosphorus, metal ions like Zinc, Copper, Iron and Manganese as well as the heavy metals like Cadmium, Chromium, Lead and Mercury .

As organic matter is key determinant in survival and activity of heterotrophic bacteria in soil, the samples were processed initially for organic matter content. Based on organic matter percentage, the collected soil samples were categorized into three groups.

A. Soil samples with organic matter ranging between 0 to 0.5%
B. Soil samples with organic matter ranging between 0.5 to 1%
C. Soil samples with organic matter ranging between 1 to 2%

These samples then analyzed for physicochemical properties.

Enumeration of Azotobacter sp from soil samples:

One gm of soil samples under investigation was added in 10 ml of sterile saline for preparation of suspension and serially diluted in sterile saline from 10^{-1} to 10^{-8}. 0.1 ml suspension of respective dilution was inoculated by spread plate method on Winogradsky's nitrogen free mineral agar medium and plates were incubated at 30^{o} C for 48 hrs. After incubation total colony count was taken

Statistical analysis:

Correlations of soil physicochemical properties and count of free living aerobic nitrogen fixers were derived from Pearson's Simple Correlation coefficients. Statistical calculations were performed using SPPS statistical software.

Result and Discussion:

The Azotobacter is an important rhizobacteria found in soil and rhizosphere. It enhances plant growth and yield through nitrogen fixation and producing plant growth promoting substances. The survival and performance of Azotobacter species mainly depends on soil physicochemical properties. The agricultural soils of Nanded are not uniform in soil type and composition and also have varied fertility and productivity. Therefore low fertile soils of Nanded are analyzed for physicochemical properties. Understanding of factors responsible for inhibition of plant growth promoting activities of Azotobacter species is indispensable for better management of soil fertility and productivity.

The thirty one soil samples were used for physicochemical properties study have varied color viz. Black, brown, red and five different textural classes on the basis of % of sand, clay and silt (Table 1).

Table 1: Textural classes and organic matter content of soil samples

Character / Sample no.	Colour	Textural class	Organic matter content (%)	Soil Category
SC	Black	Clay loam	2.38	Control
S1	Brown	Loamy sand	1.01	C1
S2	Black	Sandy Clay	1.36	C3
S3	Black	Loam	1.36	C4
S4	Black	Loam	1.39	C5
S5	Brown	Loam	1.36	C6
S6	Black	Clay loam	1.36	C7
S7	Brown	Clay loam	1.15	C8
S8	Black	Clay loam	1.27	C12
S9	Black	Sandy clay	1.32	C10
S10	Black	Clay Loam	1.60	C11
S11	Red	Sandy Loam	0.81	B7
S12	Brown	Loam	0.55	B2
S13	Brown	Sandy Loam	0.44	A6
S14	Black	Clay Loam	1.01	C2
S15	Brown	Sandy Loam	0.60	B3
S16	Brown	Clay Loam	1.39	C9
S17	Red	Sandy Loam	0.46	A7
S18	Brown	Loam	0.96	B10
S19	Brown	Sandy Loam	0.20	A1
S20	Brown	Sandy Loam	0.87	B9
S21	Black	Clay Loam	0.67	B6
S22	Black	Sandy loam	0.36	A5
S23	Black	Clay Loam	0.60	B5
S24	Brown	Loam	0.55	B1
S25	Black	Sandy loam	0.30	A3
S26	Black	Sandy Loam	0.48	A8
S27	Black	Loam	0.60	B4
S28	Black	Clay Loam	0.86	B8
S29	Black	Sandy	0.36	A4
S30	Brown	Sandy Loam	0.29	A2

The formation of soil is mainly affected by rocks, topography, climate, vegetation and agronomic practices. Hence, the texturally varied nature of analyzed soils is expected to occur due to geographical impact.

The organic matter and carbon content was observed less in studied soil samples as compared to control soil. The organic matter content (%) of soil samples varied significantly in the range of 0.20 to 1.6 which were used for categorization of soil samples into three types. The eight out of thirty samples belong to Category A, 10 belong to Category B and 12 belong to Category C. The organic matter and carbon content was observed less in studied soil samples as compared to control soil. The organic carbon of experimental soils was ranged between 0.117 to 0.98% which was comparably lower than control soil (2.38%). Soil organic carbon plays an important role in soil biological (provision of substrates and nutrients for microbes), chemical (buffering and pH change) and (stabilization of soil structures) physical properties. Bacchewar and Gajbhiye[9] analyzed 20 sites of Latur district of Marathwada for organic carbon (%) and observed the organic carbon content was in range of 0.42 to 0.94%.

The physicochemical analysis of category 'A', 'B', 'C' soil samples is showed that the water holding capacity organic carbon, available phosphorus, pH, calcium, potassium Cr, Cd, Pb and population of free living aerobic nitrogen fixers varied considerably over control (Table 2).

In the present study, the population of Azotobacter sp in analyzed soils is less and ranged between 15×10^1 to 98×10^2 CFU/g for experimental soils and 189×10^4 CFU/g for control fertile soil. The soil acidity, soil fertility, soil textures, vegetation type influences the population of microorganisms in soil and rhizosphere. The Azotobacter sp also responds varyingly with different soil properties. Panaiyadiyan and Chellaia [10] determined the population of Azotobacter from rhizosphere soils of Pachmalai hills of Tamilnadu and reported up to 10^7 to 10^8 CFU/g population of Azotobacter from six samples whereas other six analyzed samples did not showed existence of Azotobacter.

The Pearson correlation coefficients between physicochemical properties of soil and free living aerobic nitrogen fixers are indicated in Table 3. A positive and statistically significant correlation was observed with water holding capacity, organic matter and available phosphorus in all three categories of soils. A positive but statistically non-significant correlation was observed with available calcium content. A negative correlation has observed with EC, pH and available potassium, Cu, Ni, Fe, Zn, Pb, Cr and Cd in all three samples. The water holding capacity, organic carbon content and available phosphorus in soil showed a significant positive correlation with the population of

Azotobacter sp. These finding indicate that Azotobacter sp are heterotrophic and their growth is influenced by the availability of utilizable carbon source. The Azotobacter sp has relatively high demand of phosphorus to generate ATP for fixation of atmospheric nitrogen. The moisture content increases nutrient mobility and availability of organic carbon and phosphorus in soil. Therefore higher water holding capacity, organic carbon content and available phosphorus have increased population of Azotobacter. Similarly Kizilkaya[11] showed a significant positive correlation of Azotobacter population in soil with organic matter content.

Table2: Profile of Soil Physicochemical properties

Soil property	Soil sample	
	Control	**Samples under investigation**
W.H.C.(%)	78	31 - 63
Organic carbon (%)	2.38	0.12 - 0.95
Organic matter (%)	4.145	0.20 - 1.63
EC (ds/m)	0.65	0.10 - 1.45
pH	7.03	6.25 - 9.77
P (ppm)	76.2	13.2 - 38.36
Ca (ppm)	5.01	1.23 - 12.25
K (ppm)	315.20	80.52 - 1064.45
Cu (ppm)	2	2 - 28
Ni (ppm)	ND	1.53 - 13.52
Fe (ppm)	4.7	2 - 74
Mn (ppm)	2	2.19 - 49.32
Zn (ppm)	0.4	0.20 - 4
Pb (ppm)	ND	1 - 49
Cr (ppm)	ND	2 - 38
Cd (ppm)	ND	1 - 23
C.F.U. of N_2 fixers/gm	189×10^4	15×10^1 - 98×10^2

ND: Not detected

The electrical conductivity, pH, Cu, Ni, Fe, Cr, Pb and Cd showed a negative significant correlation with Azotobacter population. These findings revealed the importance of optimum concentration and critical level of these factors for survival of Azotobacter sp. Positive and nonsignificant correlation with calcium and potassium indicated their less impact on growth of Azotobacter sp.

Table 3: Pearson correlation coefficients between physicochemical properties and nitrogen fixers

Property of soil	A (below 0.5%) (n=8)				B (between 0.5 to 1%) (n=10)				C (between 1 to 2 %) (n=12)			
	Mean	**S.D.**	**r**	**t**	**Mean**	**S.D.**	**r**	**t**	**Mean**	**S.D.**	**r**	**t**
W.H.C.	58	8.01	+0.883[b]	3.458*	51	9.41	+0.88[b]	5.17*	43.65	7.51	+0.94[a]	8.73*
Org.Carbon	0.211	0.056	+0.847[b]	3.266*	0.411	0.08	+0.90[a]	5.834*	0.76	0.11	+0.81[b]	4.338*
E.C.	0.472	0.121	-0.78[b]	3.023#	0.258	0.090	-0.95[a]	8.477*	0.35	0.20	-0.79[b]	4.09*
pH	7.69	0.88	-0.66[c]	2.153	7.93	1.06	-0.43[d]	1.346	8.13	0.96	-0.90[a]	6.538*
Available P	26.26	4.37	+0.76[b]	2.864#	26.34	7.07	+0.97[a]	11.16*	32.73	5.60	+0.733[c]	3.391*
Available Ca	5.19	1.47	+0.149	1.491	5.40	2.52	+0.36[d]	1.089	7.61	2.72	+0.154	0.479
Available K	392.03	268.94	+ 0.113	0.191	506.53	233.19	-0.17	0.486	744.85	213.91	-0.13	0.413
Cu	11.36	8.85	-0.814[b]	2.960#	15.6	8.47	-0.39[d]	1.194	4.5	2.571	-0.17	0.545
Ni	5.14	3.82	-0.92[a]	3.385*	5.78	4.20	-0.51[d]	1.61	4.73	3.68	-0.30[d]	0.994
Fe	36	24.28	-0.74[c]	2.328#	5.6	4.97	-0.39[d]	1.194	2.83	2.62	-0.24	0.781
Mn	4.66	3.61	+0.192	0.673	17.30	15.38	-0.49[d]	1.610	12.51	9.48	-0.13	0.413
Zn	1.54	0.89	-0.14	0.573	1.15	0.744	-0.26	0.759	1.00	0.318	-0.118	0.375
Pb	16	14.07	-0.612[c]	1.27	5.3	5.27	-0.31[d]	0.92	13.41	11.71	-0.91[a]	6.94*
Cr	8.76	7.49	-0.925[a]	3.033#	5.5	3.86	-0.67[C]	2.545#	8.00	6.149	-0.86[b]	5.32*
Cd	18.25	13.28	0.845[b]	2.956#	17.3	11.47	-0.76[b]	2.462#	14.83	12.30	-0.88[b]	5.79*
Count of N_2 fixers	571.25	482.74	-	-	676	612.50	-	-	3172.5	3068.74	-	-

a. Very high degree of correlation b. Sufficiently high degree of correlation

c. Moderate degree of correlation d. Possibility of correlation

* Significant at 5% and 1% P levels # Significant at 5% P level only

Conclusion:

The physicochemical analysis of soil samples indicated that soil physicochemical parameters of selected low fertile soils of Nanded are varied from a fertile and good quality productive soil. The factors like organic carbon, phosphorus, soil pH, and metal ions affected the survival of Azotobacter population and needs to be manipulated for enhancing soil fertility and productivity.

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Mango Plant Galls Caused By Midge Fly

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Family Anacardiceae is known for wealth of galls and extensively distributed in India and other parts of the world. Presently more than 35 leaf galls, two shoot axis galls and bud and inflorescence galls are reported from India[1]. Majority of galls are caused by midge flies belongs to family ceciodomyddae of order Diptera. Some galls are also caused by aphids, psyllids and mites also.

Mangifera indica is extensively cultivated in this region (Marathwada) of Maharashtra state. Various varities of mango like Keshar, Nilam, Malgoba, endogenous varieties are cultivated on large scale in this region. Mango popularly known as "king of Fruits" is known for medicinal as well as horticulture crop. It is a cash crop of this region. The leaves, bark, gum, resin, fruits and seeds are of medicinal importance.

Leaf gall of *Mangifera indica* caused by *Procontarina nandedensis*: leaf gall, Amphiphyllous, visible from both sides, more hypophyllous and lesser epiphyllous, protuberance, sessile, hard, unilocular, single maggot in the larval cavity. Gall size variable each leaf have more than 25 galls.

Ecological notes: gall formation was noticed during August to September months of year. The galls appear initial as dots and elongated later. Initially the color is dark green but later on turn yellowish on maturity. Emergence of adults noticed during November and December.

Distribution: previously Rao and Grover[2] reported it from Uttar Pradesh. Presently this gall was collected and reared from Agriculture School, near Pawadwewadi Naka, Nanded, Maharashtra.

Inflorescence galls of *Mangifera indica* L caused by *Procystiphera mangifera* Felt. It is a known flower bud gall caused by unknown gall midge. Previously it was reported by other taxonomists from India and state also. From Nanded it is reported first time.

It is a flower bud gall. Flower buds modified into a small conical swelling, smooth, fleshy, solid, broad basally and pointed apically. Initially galls pale green and turns reddish

brown on maturity. Larval cavity single and spacious with 2-3 larvae inside. Size variable 5-6 mm long anf 2-3 mm thick. Each flower with many galls.

These gall formations observed from December to January months. Pupation occurs outside of gall i.e . in soil. Emergence of adults occurs in February.

Earlier this gall was reported from Aurangabad (M.S.) by Prasad and Grover[3]. Now it is reported from Nanded, Parbhani and other parts of region where mango plantation occurs.

Stem or shoot gall caused by *Procystiphora mangifera* Felt was found to be reported from Study area. It is subglobose, oval, solid, indehiscent with single larval cavity. Many maggots found inside a gall. Size of galls vary from 2-5 mm long and 2 mm in thick. Theses galls was reported during October- November months. Emergence occurs in late December

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'NEPTUNE AEGAGROPILI' - IN MICRO PLASTICS CLEAN UP

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Abstract:

Posidonia oceanica (Neptune grass or Mediterranean tape weed) is an endemic sea grass that belongs to one of the marine's flowering plants that occupied during Cretacean period and found at depths of 1-35 metres in Mediterreanean. In shallow and coastal waters they form meadows on muddy and sandy bottoms and involved in 400 g of carbon production per square metre per year. It plays an essential role in the carbon sequestration to tackle climate change. The potential uses of sea grass includes fertilisers, animal fodder, packing material, mattress filling and in weaving objects and it is considered as third most valuable ecosystem. The fibres from the *Posidonia* leaves knotted all together by seawater motion and results in "aegagropili". Recent researchers analyzed that Neptune aegagropili can trap microplastics in coastal areas in the form of filaments, fibres, and fragments of polymers (Polyethylene terephthalate) and helps to protect and preserve vulnerable ecosystems.

Keywords: sea grass, ecosystem, climate change, micro plastic, endemic, carbon, fibre and polymer.

Posidonia oceanic:

P. oceanica (Potamogetonaceae) is one of the most prominent coastal ecosystems that occupy 12,247 km^2 in Mediterranean Sea and even though it possesses several beneficial properties such as supporting marine food webs and providing habitat to flora and fauna[1], this seagrasses are alarmingly decreasing due to climate change and anthropogenic activities. It is long living, endemic and grows most predominantly in coastal shallow waters. Nearly 1.5% and 29% of seagrass has been lost every year and vanished globally since 1879[2]. *P. oceanica* exists as creeping rhizomes (plagiotropic) and erect

rhizomes (orthotropic) based on space availability. Shoot has 4-8 leaves with 8-11 mm wide and 20-80 cm long. The high summer temperature (20^0C) leads to flowering and it takes 6-9 months for the fruits to ripen. It possesses only one seed and germination is through *in situ*. The growth is maximum at a salinity level between 33% to 46% and temperature is 9.0^0C and 29.2^0C respectively. The primary production from *P. oceanica* are rich in cellulose, lignin and consists of edible Rhodobionta and Chromobionta for herbivores[3].

It uses the substrate existing in underwater for anchorage and nutrient uptake. It uses oxygenated sediment and prefers to grow on sand and rocks. *P. oceanica* differ in morphology and gentic difference from different regions[4]. The primary production of *P. oceanica* is measured by leaf measuring and determining photosynthesis. It was recently found that *P. oceanica* can potentially cleanup micro plastics in oceans.

Plastics are ubiquitous in nature and its production is sharply increased in last many years that leads to serious threaten to ecosystem when not properly disposed or recycled. Plastic litter occupies 60-80% of litter in total and of which 10% ends up in oceans. The materials such as beverage bottles, packing straps and tarps, synthetic nylon materials are slow to degrade and when exposed to sunlight it will photo degrade. Every year, 8 million metric tons of plastic ended up in oceans. This may reach 20 times the 8 million metric tons by 2025. The buoyant nature of plastic allows travelling in currents for thousands of miles thereby threatening ecosystem. The plastics released into the oceans have varied degradation rate based on polymer densities. Degradation along with physical abrasion leads to plastic weathering that results in the formation of micro plastics[5]. According to Sanchez-Vidal *et al.*[6] micro plastics are less than 5 mm in size and obtained from large plastic items, virgin plastic pellets, cosmetic micro beads and clothing microfibers that leads to ocean pollution. The accumulation of micro plastics in seafloor sediments is a great menace to ecosystems. The sedimentation of microplastics is highly influenced by physical, chemical and biological mechanisms and settling of microorganisms, cohesion on phytoplankton, aggregation with debris and small particles will build-up the settling process of micro plastics. The parameters such as coastal stroms, offshore convection and saline subduction lead to migration of micro plastics to a greater depth[5].

The decomposition rate of plastics found on coasts is as follows,

Foamed plastic cups: 50 years

Plastic beverage holder: 400 years

Disposable diapers: 450 year

Plastic bottle: 450

Fishing line: 600 years

The small plastic pellets called 'mermaid's tears' formed due to domestic plastic waste and industries are wide spread across the oceans. These accumulated plastics in seas are also known to release toxic bisphenol (BPA) and PS oligomer and metabolized to ingestion. As a result, several marine species such as whale, sea lions, turtle, fishes, birds and zooplankton encountering serious of adverse effects from entanglement and ingestion of plastic debris both onshore and offshore. This ingested plastic can retain within organisms and moved to different tissues affecting cellular pathways, blocking digestive tract, lodging in windpipe, filling stomach, malnutrition, starvation and finally death[5].

Recently researchers in Spain have found that, 'Neptune balls' which is formed due to natural bundles of fibre under water can trap 900 million pieces of plastic items in Mediterranean every year. Marine seagrass are belongs to several families and are of 70 species, that are recolonised the ocean 80m to 100 m years ago. The five seagrass found in Mediterranean Sea are *P. oceanica*, *Cymodocea nodosa* Ascherson, *Zosera marina L.*, *Z. noltii* Hornemann and *Halophila stipulacea* Ascherson. *P. oceanica* (most dominant seagrass) alone can take up to 600 bits of microplastics per kg of leaves[7]. It is a monocot belongs to order Alismatales and family Posidoniaceae; present in coastal system of meadows[8].

Biological and ecological role of *P. oceanic*:

P. oceanica is most productive ecosystem and vagile fauna[9]. It plays an essential role in biological and ecological for establishing the balance of coastal waters and its related activities[8].

- Food base for many species of macro herbivores
- Oxygen production
- Planet's most productive ecosystem
- Biodiversity hotspot
- Effective in absorbing hydrodynamism
- Makes coastal water transparent
- Stabilize the coastal sand dunes
- Protect from coastal erosion
- Managing living resources
- Act as bioindicator
- Global carbon cycle

Regression of *P. oceanic*:

Due to human pressures, *Cystoseira senu latu* and *P. oceanica* are becoming vulnerable in recent time. The considerable reduction of *P. oceanica* is due to[8]:,

- Anthropogenic activities[10]
- Building of sea walls, platforms on land claimed from sea and ports
- Hypersedimentation
- Erosion
- Turbidity
- Water pollution
- Plume of fresh water during floods
- Reduction in water transparency
- Presence of excessive amount of nutrients and chemical contaminants
- Anchoring
- Trawling
- Explosives
- Coastal aquaculture
- Laying cables and pipes
- Dumping
- Competition with introduced species
- Over grazing

Biochemical and genetic approaches are convenient biomarkers and become need of the hour. Even though trawling, anchoring, artificial reefs, seagrass-friendly moorings[4], dredging and pipeline refilling helps to restore sea grass but it takes several years to restore the habitats due to its slow growing property[2].

To conclude, marine plastic pollution is a greater threat to ecosystem which affects the food chain. Due to long life of plastic on ecosystem, several measures should be taken nationally and internationally to protect our ecosystem. Through educational campaigns and creating awareness will leads to some innovative methods in control of plastic pollution and biodegradation or collection of already prevailing plastics.

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THE LIFE OF BHIL TRIBE IN NANDURBAR DISTRICT AND ITS RELATION WITH NATURE

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Abstract:

The worldview of Indian tribes reveals tribal spiritualism i.e. their belief in supernaturals. They have created respect and reverence for animals, forests, rocks, mountains and all other things that come under the sun. The people of Bhil Community are very religious. Devotion is the principal faith of Bhils. They believe in the spirits of the jungle. The Bhils have God and Goddesses in every phase of their life. They devote a variety of Gods like Vaghdeo, Nagdeo, Ujadyadeo, Govaldeo-God of herder, Hirkulya-God of Cultivation etc. Present study also reveals the interdependence of the bhil tribe in Nandurbar district and their surrounding environment.

Keywords: Bhil tribe, Nandurbar District, Environment protection, Vaghdeo, Nagdeo

Introduction:

Every living organism on the earth is a part of the environment and cannot be separated from it. The tribal people of India for centuries have lived along with nature and utilized natural resources. They depend on their surrounding forests for their food items, shelter, fodder, fuel and health care as well as to earn livelihood through minor forest products for self consumption as well as for marketing the products[1].

The tribals have adopted such cultural mechanisms that ensure a healthy ecological balance. Their rites and rituals provide the framework of defining acceptable use of natural resources. While practicing their natural rites and rituals, clan -name system they have shown the philosophy of conservation and environmental protection by proper utilization of natural resources[2]. The social characteristics of the Bhil community are typical and these are preserved as such from one generation to another generation as it is their identity. Most of the social rituals of Bhils are about worshiping nature in the form of plants, animals, land etc. Such rituals express their relationship with the natural environment.

The social structure of Bhils is full of celebrations. They have tradition to celebrate almost all events of life from birth to death. In recent years, the forms of rituals have changed to some extent. But they welcomed these changes with maintaining their traditional formations.

The life of Bhil tribe is inseparable from God, Deities and festivals which are related to Nature. The Adiwasi Bhil community is living in harmony with Nature. Forests and hilly areas are their main habitat. They believe in natural powers and pray trees, rivers, mountains, animals, Sun, fire and wind. Wagdeo, Paludyadeo, Nagdeo etc are the names of the festivals during which they pray for particular power in the Nature. Generally from Marathi month Jeshthe to Falgun Bhil Tribe from Nandurbar district celebrate various festivals to show their gratitude towards God[3].

Waghdeo:

Adivasis pray Images of Tiger for the protection of their pet animals . Adivasis consider and worship forest animal tigers as their God. They live in forests and it is natural that they have to face tigers, snakes and wild animals while doing their day to day activities. So, Adivasis worship tigers, snakes, cobra etc. They worship tigers as God to protect and prosper them and lastly a group of people drive out tiger God out of the boundary of village. Tiger's role is played by a man in a village. They believe that by worshiping tigers, their pet animals like cows, bullocks, goats etc are protected from wild animals like tigers, lions etc[4].

Nagdev:

After waghdeo, on the very next day Adivasis worship 'Nagdeo' and this is also treated as a festival. Adivasis offer milk and worship cobra as it protects the crop from the infestation of rats and bandicoots. By worshiping cobra they contribute in maintaining ecological food chain and in conserving the species. Here it is seen that the territorial freedom of wild cobra is respected and a care for its life and existence is seen through offering of Bhog.

Paludya Dev:

Newly grown tender leaves on plants are worshiped hence the name "Paludya"**.** This God of Adivasi is worshiped in the month of May and first two weeks of June. During this period, mature leaves from the plant sheds off and new tender leaves come out. Forest inhabitant Bhil Tribe shows their gratitude not only to the crops they have grown but the trees in the forest too. After this pooja agricultural activities begin.

Nandurdeo/ Nilichari:

This is the God of newly emerged plants. As a result of the first monsoon small plants and grasses are grown in farms and forests. The mother Earth is covered by a green shawl of grasses. This new emergence, the entire greenery is appreciated and worshiped by Bhil Tribe. In this season green vegetables and tender green leafy fodder is available easily. But before the man consumes this vegetable or animals start grazing on it Tribes performs ritual of "Nilichari" by Bhagat or Pujari (priest) i.e. worship of newly emerged plants[5].

Goval Deo (God of herder):

A man who is taking care of cattle at home, farm and forest is known as Goval Deo. Goval is a person in the Bhil Tribe who takes cattle for grazing.

Hiwarya Dev:

Hiwarya which is also called Shivdev (Shiv-Boundary of village, Dev-God) is 'God of Boundary'. The shivdev is situated under a big tree or on the edge of the farm. For this the statue of clay is made by the potter who looks like a ghost and hence it is also called as God of 'Ghost'. It protects the village and farmland. While sowing and harvesting, the Adivasi people always pray it without which the Adivasi people never start any agricultural practice. This God can be seen as worship of the mysteries of nature which are not known even to the civilized modern world. It cannot be treated as superstition. Bhil tribe worships God of Boundary on every festival and tries to fulfill their wish[6].

Khal-Puja:

Before thrashing tribes perform one more ritual of worshiping Khal by offering coconut, essence stick, Liquor of Mahua etc. Depending upon the financial condition of the farmer villagers are invited for dinner on the day of "Khal Pujan". Worshiping Kahl is the sense of gratitude of Bhil Tribes towards Nature saying that for the entire year they have grown crops without any obstacle. They consider this place as sacred.

Yaha Mogi Devmogra Mata:

This is Adivasi prayer Goddess. It is also known as 'Yaha Mogi' The Devmogra Mata's temple is situated at Devmogra village in Sagbara district in Gujarat. On the festival of Mahashivratri the fair is arranged in Devmogra village. In this fair many people join together from different places. The Bhil Tribe believes that Goddess Yaha Mogi fulfills all our wishes and so she is also called as the deity of agriculture and prosperity.

Marriage ceremony of Tribes has a marked feature of worshipping the Apata tree. For tribes Apata tree is considered to be the tree of Goddess Laxmi, The tree of Wealth. As the two lobes of the leaf are attached together, Tribes also pray for the lifelong togetherness of newly married couples along with wealth. This tradition is known as "**Hengol pujan**"

Holi is a big and important festival for Adivasi residing in Nandurbar District. It is the festival of joy, entertainment and fun. It is a festival of dance and colours. It is celebrated in month falgun – on full moon day i.e. Poonam.With this it is seen that Adivasi is connected with forest only. His life and his festivals are related and affected with jungles and Nature. So, he knows in heritance how to deal with imbalance of nature, natural calamities of jungles, storage of water etc. But it is sad to say that modern culture and technology has given over pollution in air water and jungle that has affected the life of Adivasis and their culture, both are going to abolish. Adivasi have to undertake other activities to get their livelihood, putting aside their original activities of farming, fishing, and gathering[7].

The careless, faulty and unplanned developmental policies of the government are creating environmental hazards and thus forcing tribal communities, the inhabitants of forests to face adverse effects[8]. Demanding urbanization and industrialization is leading to large scale cutting of forest trees in the tribal habitat that shortens fuel, fodder, foliage and forest produce. It is necessary to protect the environment for the continuous development of tribal people.

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INCREASING POPULATION AND DECREASING ENVIRONMENT

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A sum total of living organism including physical, chemical and biotic factors, which provides living condition on earth known as environment, while people counted in a specific region called its population. Both are related to each other and impact one another. Environment belongs to all biotic and non biotic organisms so it is important to survival of every living body on earth surface. Where environmental condition bounds and gives opportunities to the human development as human beings also put good and bad effects on environment. Environment gives us atmospheric gases to live, clean air to survive fresh water to drink, agriculture land to cropping, natural resource and vegetation cover for cultural development and fulfill their basic needs. Since the human civilization begins, environment dominates because none of the economic activities harm him more. If some kind of economic activities like as shifting agriculture and utilization of natural resource for basic purpose damaged environment on a small scale it could be fix by environment itself but after the 17th century when industrialization era started from European culture and spread to another area mainly in colonial states, Blind loot of natural resource started and damaged the environment on a large scale. Rapidly increasing population and limited quantity of natural resources on earth made the situation very critical, because more the population needs more resources for survival.

It can be estimate that till the year 2025, the entire world population will be approximate 8 billion and causes more demands of food, shelter and natural resources. Their cultural development like urbanization, industrialization, transport and communication, public utilities etc. will pressurize agriculture land. On a large scale of forests cut down due to development process and hygiene of environment breaks down. More the population demands more the resources for their livings. As we know, over the earth, natural resources are not found equally. Some region has more resources as comparison to others. Consumption of resources is also not equal. Developed economies consume more resources for their living while they have only 5% of entire world's population; this is vice-versa with the undeveloped economies. Increasing demand of food

grains, drinking water, industrial development, demand for public utilities, health and wealth facilities, changing scenario of agriculture, use of fertilizers and pesticides for better production, agriculture land uses for urbanization, transportation and communication, new faces of energy resources like atomic energy and increasing quantity of CFC, CO_2, Methane gases etc. harms environmental physical conditions and its regularly increasing day by day with the increase of population.

So environmental degradation and increasing population are the burning issues in modern age for the environmentalist or social scientist and it is very difficult to conceptualize growing population and environment depletion[1].

As we Know, India has a disappointed record of population increase since the beginning of 20th century. Census 2011 reported 1210 millions of total population, which is 5 times more in comparison to census 1901. It has only 2.4 % of global earth's land surface to feed 17% of world's population. After independence improved health services decline death rate while growing economy and less awareness of family planning among societies resulted high birth rate which causes population explosion. Green revolution in agriculture in the decade of 60's, employment opportunities, industrialization and service sectors played an important role in population increase. But these opportunities could not contribute in balancing between population and environmental pressure. Our second largest populace developing economy has a harsh relationship with its limited natural resources and causes some environmental issues. India has 40 to 45 % of its land under cultivation, No other example seems to be like this over the entire world. During last 60 years, total cultivated area of India has increased about 20 % more and it is mostly taken by the forest cover because available land was not sufficient to feed the population in early stage of independence. According to socio-economic statistics, India 2002, Per capita availability of forests has decreased from 0.113 hectare to 0.071 hectare during the year 1950-2002, while the gross cropped area has increased 131.89 million hectare to 200.86 million hectare between the years 1951-2014, which shows the high pressure on vegetation cover in India. In spite of this economy needs raw material for the industries to generate income and employment resulted in soil degradation, deforestation, influence in ecosystem, impurity of water resources because all these maintained by the natural vegetation. Many issues like as environment failure in pollution consumption, in ecosystem protection, in ground water recharge, in climate balancing and in restore of nutrients in soil etc. emerged due to deforestation[2].

Deforestation causes loss of biodiversity. All around the world on an average one thousands of animals species and twenty thousands of flowering plants thrown to be at risk[3] and all this happens due to increasing demand of socio-economic development such as urbanization and infrastructure building which causes deforestation. Besides this

increasing population demands more consumption of energy resources like as Coal energy, Crude Oil, hydro electricity and atomic energy etc. Consumption and burning of fossil fuels (coals & Petroleum) for commercial, industrial, transportation and for domestic purposes are the major sources of environmental pollutants which mainly pollutes the air and water. Because of fossil fuel combustion percentage of Methane, Carbon Monoxide, Niters Oxide, CO_2 and other green house gases are regularly increasing in the atmosphere, which causes health and environment associated issues. All around the world, per year 900 million metric ton of CO_2 gas emits in the atmosphere by the transport vehicle and causes environment acidic and ozone depletion. According to Energy Statistics India 2018, during the year 2016-17 trend of growth rate in energy source consumption to previous year is 0.6 % in Coal energy, 2.24 % in Lignite, 5.24 % in Crude oil, 6.12 % in Natural gas and 6.5 % in electricity. The production of coal has increased approximately 10 times while petroleum production has increased 29 times in the country during the latter half of 20th century[4].

More over urbanization also impacts environment. In the year 1901 India reported 11.4 % of its total population as urban population[2], while it becomes 31.2 % of total population in Census, 2011. It will be enlarged in the next census year 2021. In search of earnings and better livings, thousands of people move towards urban areas. Miserable condition of medical infrastructure, unemployment, shortage of education institutes etc are the leading agents of rural to urban migration. But this type of unformulated migration gives birth to urban humiliation which results in the form of air and water impurity, sewerage problems, slums and urban poverty in the form of land utilization. Because of Air pollutants our mega cities mainly Delhi NCR region (National Capital Region) becomes very harmful for human health basically in winters when suspended material of construction, combustion of fossil fuel/petroleum and burning of agriculture wastages in surrounding NCR causes lungs and heart diseases to their citizens and has risen significantly in Indian Megacities[5, 6]. Mode of transportation also infects the air with lead due to transport exhaust.

Most of the water resources consumed in agriculture and livestock while one fifth of water in industries and domestic consumption. Many fertilizer industries mix their waste material in the reservoirs and pollute the water. The Industrial, chemical and electronic wastes damage water qualities and mixing of human excrement in the water through sewerage system causes diarrhea, hepatitis, typhoid, guinea worm, dysentery etc. [4]. Soil degradation is also an important problem. Extra use of fertilizers and pesticide damage the upper layer of soil and enlarged nitrous oxide in the soil particles, which impacts the soil productivity. In the recent decades, blind consumption of energy enlarged CO_2 and green house gases in the environment which resulting in global warming. Global warming produce delay in seasons, disrupt the environment, increase in temperature, decrease in

glaciers, shrinking wetlands and heat stress on earth. All these would be have socio-economic consequences[3].

So we can say increasing population contributes in exploitation of resources and environment. The poor economy and their helpless social infrastructure pressurize environment and throw it in miserable condition. Environment depletion hits sustainable development and put bad impacts on human health also. It is not the duty of administration alone to save the environment, Human society also should take some initiative to clean and protect the environment. For this we need to spread awareness among societies to implement the curative measures, which preserve our ecosystem. Conservation programs basically for forests and river water resource should be adopted. There is an urgent need to take steps against mismanagement of economy, urgent need to regulate population control planning system and setup a machinery to provide a healthy environment to every human being.

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ANALYTICAL STUDY OF SNF AND FAT PERCENTAGE IN COW AND BUFFALO MILK

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Abstract:

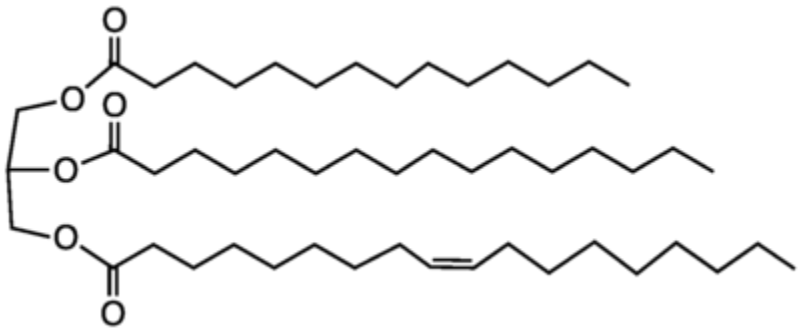
Milk is a white liquid produced by the mammary glands of mammals. It is the primary source of nutrition for young mammals before they are able to digest other types of food. Early-lactation milk contains colostrum, which carries the mother's antibodies to the baby and can reduce the risk of many diseases in the baby. It also contains many other nutrients.[1] In present work different sample were taken from different cow and buffalo and fat and snf %were analysed by standard method.[2]

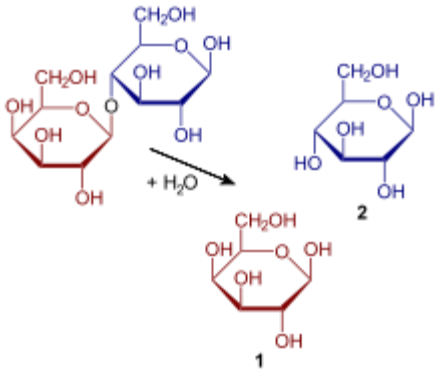
Keywords: Milk, Fat, SNF, Colloid, Galactose.

Introduction:

Physical and chemical properties of milk:

Milk is an emulsion or colloid of butterfat globules within a water-based fluid that contains dissolved carbohydrates and protein aggregates with minerals.[2] Because it is produced as a food source for a neonate, all of its contents provide benefits to the growing young. The principal requirements of the neonate are energy (lipids, lactose, and protein), biosynthesis of non-essential amino acids supplied by proteins (essential amino acids and amino groups), essential fatty acids, vitamins and inorganic elements, and water.[3-10]





Butterfat is a triglyceride (fat) derived from fatty acids such lactose molecule broken into glucose as myristic, palmitic and oleic acids and galactose.

Methodology:

Milk samples were taken from different cow and buffalos. The fat %of each sample were analyzed with the help of standard method by using semi automatic fat measuring machine.Total solids content is the entire residue left after complete evaporation of water from milk. This includes fat protein, lactose and mineral matter. These solid constituents exist in milk in a mechanical mixture.

Determination of S.N.F. (Solid Not Fat) and Total Solids of Milk [11-14]

Total solids can be determined by (i) Gravimetric method, (ii) By use of formula, (iii) By Richmond's scale

I) Gravimetric method:

i. This is an accurate method but not practicable and hence is not used.

ii. Take flat bottomed 50 cm diameter porcelain crucible.

iii. Clean and dry in hot air oven for 1 ½ hour.

iv. Not the weight of crucible.

v. Add 5 ml of milk sample and weight it.

vi. Put the crucible in hot air oven adjusted at 100 0 C for 3 to 4 hours.

vii. Remove the crucible from oven and cool in desiccators' and weight.

viii. Again put the crucible for ½ hour in oven.

Remove the crucible from oven and cooled in desiccators' and weigh.

This process should be continued/repeated till getting the constant weight or difference in last two weights should not exceed 0.01 gm. The total solids are determined by formula.

$$\text{Total solids \%} = \frac{\text{Weight of residue}}{\text{Weight of milk sample}} \times 100$$

II) By use of Formula:

i) Determine the fat percentage of milk sample by Gerber's method.

ii) Take out the lactometer reading and temperature of milk and calculate.

Corrected lactometer

iii) Place the figures of fat and CLR in the following formula for calculating total solids and solids not fat.

Richmond's Formula:

$$\text{Total solids \%} = \frac{\text{CLR}}{4} + 1.21\,F + 0.14$$

$$\text{SNF \%} = \frac{\text{CLR}}{4} + 0.21\,F + 0.14$$

ISI Formula

$$\text{T.S. \%} = \frac{\text{CLR}}{4} + 1.22\,F + 0.72$$

$$\text{SNF \%} = \frac{\text{CLR}}{4} + 0.22\,F + 0.72$$

Where CLR = Corrected lactometer Reading, F= Fat content in milk

Result and Discussion:

Different samples of milk were analyzed. The samples were studied in the lab of Grasim dairy two suppliers (Pal and Sodani) supplied samples temperature and quantity of milk was same but fat and snf value of cow and buffalo were different. The study shows that fat was greater than 5.5 of each sample snf and fat value of cow milk found greater than buffalo milk. Milk samples were also analyzed in morning and in night and found that quality of milk was better in night.

Table 1: Analysis of Cow milk:

Sr. No.	Qty. Ltrs	Temp	LR	CLR	FAT	SNF
1	50	26	24	24.3	5.5	7.89
2	50	26	26	26.3	6.0	8.52
3	50	26	25	25.3	6.8	8.47
4	50	26	27	27.4	8.6	9.44
5	50	26	26	26.4	6.5	8.65

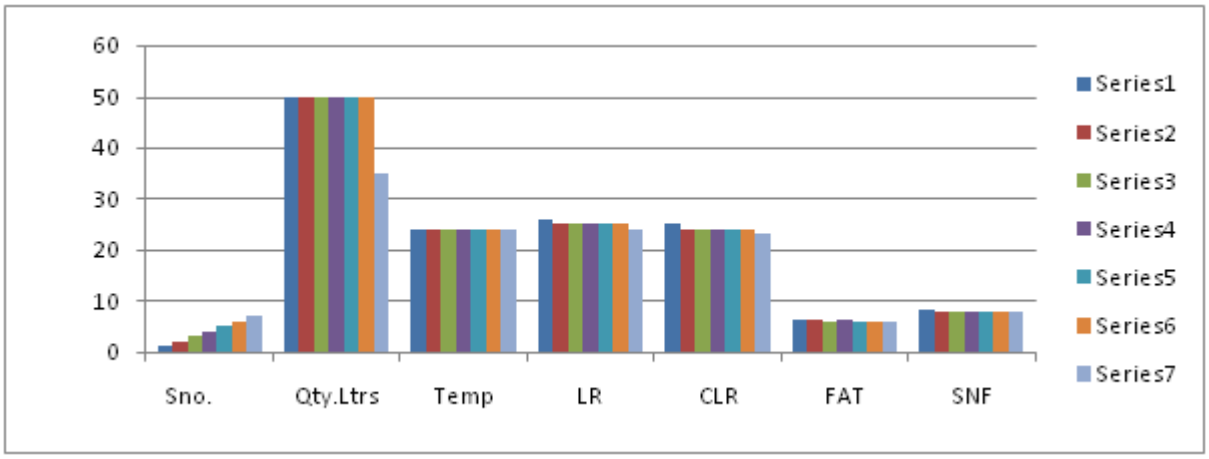


Figure 1: Graphical representation of Cow milk analysis

Table 2: Analysis of Buffalo milk:

Sr. No.	Qty. Ltrs	Temp	LR	CLR	FAT	SNF
1	50	26	26	25.7	6.0	8.37
2	50	26	25	24.7	6.0	7.90
3	50	26	24	23.7	5.8	7.82
4	50	26	24	23.7	6.0	7.87
5	50	26	24	23.7	6.1	7.89

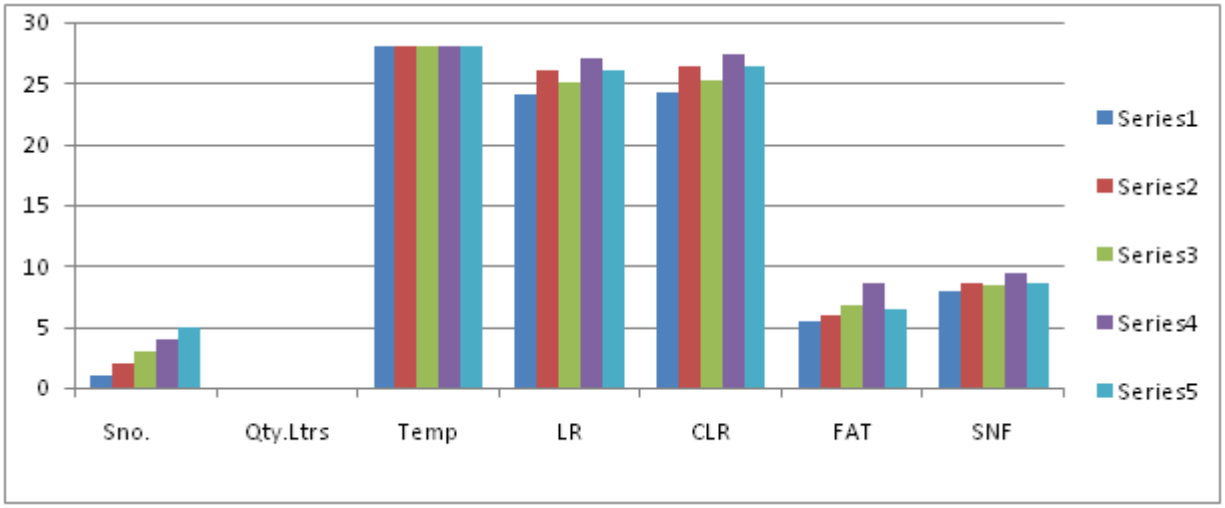


Figure 2: Graphical representation of Buffalo milk analysis

Table 3: Analysis of cow milk at two collection centres during night shift

M/S Sodani Brothers								M/S Pal Dairy						
Sr. No.	**Qty. Ltrs**	**Temp**	**LR**	**CLR**	**FAT**	**SNF**		**Sr. No.**	**Qty. Ltrs**	**Temp**	**LR**	**CLR**	**FAT**	**SNF**
1	50	26	26	25.7	6.0	8.37		1	62	27	26	26.0	5.8	8.39
2	50	26	25	24.7	6.0	7.90		2	62	27	25	25.0	5.7	8.12
3	50	26	24	23.7	5.8	7.82		3	62	27	24	24.0	5.5	7.82
4	50	26	24	23.7	6.0	7.87		4	62	27	24	24.0	5.7	7.87
5	50	26	24	23.7	6.1	7.89		5	62	27	24	24.0	5.6	7.84
6	50	26	24	23.7	5.7	7.79		6	62	27	24	24.0	5.5	7.82

Table 4: Analysis of cow milk at two collection centres during morning shift

M/S Sodani Brothers								M/S Pal Dairy						
Sr. No.	**Qty. Ltrs**	**Temp**	**LR**	**CLR**	**FAT**	**SNF**		**Sr. No.**	**Qty. Ltrs**	**Temp**	**LR**	**CLR**	**FAT**	**SNF**
1	50	24	26	25.0	6.3	8.27		1	62	24	26	25.0	6.0	8.19
2	50	24	25	24.0	6.2	7.99		2	62	24	26	25.0	5.9	8.17
3	50	24	25	24.0	6.0	7.94		3	62	24	25	24.0	5.8	7.89
4	50	24	25	24.0	6.1	7.97		4	62	24	24	23.0	5.4	7.54
5	50	24	25	24.0	5.8	7.89		5	62	24	24	23.0	5.5	7.57
6	50	24	25	24.0	5.7	7.87		6	62	24	24	23.0	5.5	7.57

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WATER QUALITY ASSESSMENT OF BHARPUR HILL STREAM, GARHWAL HIMALAYA, UTTARAKHAND, INDIA

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Abstract:

Physico-chemical parameters play a major role in determining the water quality in the hill streams. The present study was conducted to assess the Physico-chemical parameters of Bharpur hill stream for one annual cycle (September 2013- August 2014) at three sites. All the physico-chemical parameters have been analysed by standard methods. Water velocity ranged from 0.52- 0.80ms^{-1} (0.64±0.08), DO from 7.38-11.13mgl^{-1} (8.76±1.23), Free carbon dioxide 0.52-0.16mgl^{-1} (0.30±0.11). Total alkalinity ranged from 50.46-96.2mgl^{-1} (71.74±16.07). Total hardness from 29.7-43.7mgl^{-1} (36.56±5.30), nitrate from 0.03-0.07mgl^{-1} (0.05±0.01) and phosphates from 0.06-.12mgl^{-1} (0.19±0.28) were recorded. The water pH ranged from 7.21-7.92 (7.59±0.24) and was alkaline throughout the year. Pearson correlation coefficient was analyzed among various physicochemical parameters. Water temperature, pH, transparency, Hardness, dissolve oxygen and alkalinity fluctuated widely according to seasons and there is a positive correlation among them.

Keywords: Garhwal Himalaya, Hill Stream, Physico-chemical parameters, Pearson correlation Analysis

Introduction:

Water is vital for life activities and is indispensible for human existence. It can be obtained from a number of sources like lakes, rivers, streams, ponds etc. Nature is the only habitat where clean, pure and safe water exists but due to some environmental factors and human activities, nature soon starts polluting. This is the reason that the water quality is a current environmental issue worldwide (Ouyang, 2005, Shrestha *et. al.* 2007). The physico-chemical means are useful in detecting effects of pollution on the water quality (Kaushik and Saksena, 1995). The physico-chemical parameter of any aquatic ecosystem indicates

the type, composition and diversity of biotic components of that ecosystem (Hutchinson, 1957, Ruttner, 1963). Although several literatures exist on the hydrobiology of the streams, rivers and lakes of Garhwal are (Singh *et al.* 1982, 1994, Sharma, 1984, Agarwal *et al.* 2003, Sharma et al. 2007, Khanna *et al.* 2010, Matta, 2014, Balodi, 2015, Singh *et. al.* 2016, Sharma *et. al.* 2016). The present study was conducted to quantify whether the water quality of Bharpur hill stream is suitable for drinking purpose or not and to detect the impact of anthropogenic pressure on the stream as there has no previous record or study have done to assess the water quality of the stream.

Material and Methods:

Study area:

The study area i.e. 'Bharpur hill stream' catchment is one of the micro-watersheds of the river Ganga in the Tehri Garhwal district of Uttarakhand. Bharpur hill stream originates from the Shivpuri range and at the last passing it between Tilwal and Kharkola village make confluence with the river Ganga. The study area is located between latitude 30° 06' 02.84" N and longitude 78° 35'39.6" E. It has an average elevation 517 masl.

Collection of water samples:

Monthly sampling was conducted during the period of September 2013 to August 2014 spreading into four seasons (autumn season = September 2013 to November 2013; winter season = December 2013 to February 2014; summer = March 2014 to May 2014; monsoon = June 2014 to August 2014) accordingly (Balodi, 2015).

Processing of water samples:

Parameters like air temperature and water temperature were recorded with a centigrade (0-110^{o}C) thermometer. The mean velocity was measure using electromagnetic current meter (Model-PVM-2A). pH was determined by pH meter on the spot and in the laboratory by control dynamics pH Multi parameter meter (Model TPC 17), while turbidity was measured with the help of Deluxe turbidity meter, Model-EI 335). The other chemical parameters like dissolved oxygen, free carbon dioxide, alkalinity and hardness etc. were analysed as per standard methods (APHA, 1998), (Trivedy and Goel, 1986). Nitrates and phosphates were determined with the help of the Spectrophotometer (Model- UV-VIS Systronics 117 series). Sodium and Potassium analysed by using Flame Photometer (Model–ESICO 1385E).

Statistical analysis:

In statistical, Pearson correlation co-efficient analysis was performed between these parameters have been employed for the statistical interpretation of the data obtained from the study. MS excel was used for the statistical data analysis.

Results and Discussion:

Results of the analysis of physico-chemical parameters are presented in Table 1 and the seasonal variation data of physico-chemical parameters is in (Table 2). Pearson correlation represented in Table 3.

Temperature:

The air temperature was found to be minimum 15.6^{o}C in December 2013 and maximum 29.3^{o}C in May 2014 (20.89±3.88). Air temperature showed significant highly positive correlation with water temp. ($r=0.921$, $p<0.001$). Where as a significant highly negative correlation was observed between air temp and potassium ($r= -0.762$, $p<0.01$) during all seasons (Table 3). Minimum water temperature value 12.6^{o}C in December 2013 and maximum 22.6^{o}C was recorded in May 2014 (17.87±2.92). Water temperature showed positive and negative correlation with pH and potassium ($r= 0.978$, $p<0.001$; $r=-0.924$, $p<0.001$). Temperature is known to influence the pH, alkalinity and DO concentration in the water (Balodi, 2015).

Hydromedian depth, Transparency, Turbidity:

The hydro median depth was minimum 0.50m in March 2014 and Maximum 1.06m August 2014 (0.70±0.17). Minimum 0.52ms^{-1} velocity was found in the month of December 2013 and maximum 0.80ms^{-1} in August 2014 (0.64±0.08). The transparency was maximum 0.68m in January 2014 and minimum (0.30m) in August 2014 (0.50±0.13). The transparency showed significant positive and negative correlation with Hardness and Alkalinity ($r= 0.982$, $r=-0.992$).The turbidity was maximum 68.7NTU in December 2013 and minimum 63.8NTU in August 2014 (39.33±13.62). It also showed significant highly negative correlation with dissolved oxygen ($r=-0.890$, $p<0.001$).

pH:

The lowest pH was recorded 7.21 in January 2014 and highest 7.92 June 2014 (7.59±0.24). pH showed significant positive correlation with sodium ($r=0.987$, $p<0.001$). Alkaline pH is considered water was to be good for promoting high primary productivity (Balodi, 2015).

Alkalinity and Hardness:

Alkalinity ranged from 50.46mgl^{-1} in January 2014 to 96.2mgl^{-1} in August 2014 (71.74±16.07). Alkalinity showed positive (r= 0.994, p<0.001) and negative (r=-0.952, p<0.001) correlation with TDS and Hardness. TDS found minimum 99.89mgl^{-1} in January 2014 and maximum 139.4mgl^{-1} in June 2014 (118.19±14.47). The Hardness value was minimum 29.7mgl^{-1} in August 2014 to maximum 43.7mgl^{-1} January 2014 (36.56±5.30).

Dissolved oxygen:

DO showed marked variation as it ranged from 7.38mgl^{-1} in July 2014 to 11.13mgl^{-1} in January 2014 (8.76±1.23). Free CO_2 recorded maximum 0.52mgl^{-1} in August 2014 and minimum 0.16mgl^{-1} in January 2014 (0.30±0.11). Dissolved oxygen showed significant highly positive correlation with hardness (r=0.981, p<0.001) similar results (Sharma et al. 2011). Dissolved oxygen was found maximum during the winter months similar observation was recorded by (Sharma et al. 2007) in Chandrabhaga stream.

Nitrates and phosphates:

Nitrate concentration was found minimum 0.03mgl^{-1} in the months of September 2013, January and May 2014 and maximum 0.07mgl^{-1} in the month of August and October 2014 (0.05±0.01). Phosphate was recorded minimum 0.06mgl^{-1} and maximum 1.12mgl^{-1} in February 2014 (0.19±0.28). Nitrates and Phosphates showed a decreasing trend from October to January similar observation was recorded by Sharma et al (2007) in Chandrabhaga stream.

Sodium and Potassium:

Sodium and potassium contents in the stream showed an irregular trend in their concentration with maximum sodium concentration 5.41mgl^{-1} in July 2014 and minimum 1.93mgl^{-1} in January 2014 (4.11±1.08) and maximum potassium concentration 1.46mgl^{-1} December 2013 and minimum 0.92mgl^{-1} in September 2013 (1.17±0.28).

Conclusion:

The study showed seasonal fluctuations of physico- chemical parameter of Bharpur stream. The water of Bharpur stream is suitable for drinking purpose and other human use. Based on our findings, we recommended that the local government should address these issues in an effective and sustainable manner in order to protect, sources of drinking water.

Acknowledgement:

The authors are thankful to the local people for their cooperation during the study period.

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Table 1: Monthly variation in physico-chemical parameters of Bharpur Stream Sep 2013- Aug 2014

	Autumn			Winter			Summer			Monsoon					Average
	Sep	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Min**	**Max**	**± SD**
Air Temp.(°C)	18.2	17.5	17.2	**15.6**	18.6	19.6	21.33	26.6	29.3	23.6	20.6	22.5	15.6	29.3	20.89±3.88
Water Temp.(°C)	16.8	15.7	16.3	12.6	14.3	16.1	18.66	21.2	22.6	20.8	18.9	20.5	12.6	22.6	17.87±2.92
Hydro median Depth (m)	0.73	0.71	0.69	0.65	0.63	0.58	0.5	0.57	0.59	0.66	1.04	1.06	0.5	1.06	0.70±0.17
Velocity(ms^{-1})	0.54	0.58	0.67	0.52	0.63	0.63	0.56	0.62	0.61	0.74	0.75	0.8	0.52	0.8	0.64±0.08
Transparency (m)	0.51	0.53	0.54	0.66	0.68	0.72	0.42	0.44	0.47	0.36	0.34	0.3	0.3	0.72	0.50±0.13
Turbidity (NTU)	57	38	52.4	18.7	23.6	31.2	27.3	41.2	37.7	29.3	51.7	63.8	18.7	63.8	39.33±13.62
pH	7.46	7.53	7.57	7.26	7.21	7.27	7.72	7.77	7.81	7.92	7.81	7.78	7.21	7.92	7.59±0.24
Alkalinity(mgl^{-1})	62.2	63.3	68.6	51.27	50.46	52.21	67.13	83.13	87.16	84.57	94.6	96.2	50.46	96.2	71.74±16.07
TDS (mgl^{-1})	109.1	113.2	106.3	102.2	99.89	102.6	112.7	127.9	132.9	139.4	135.6	136.5	99.89	139.4	118.19±14.47
D.O. (mgl^{-1})	8.67	8.12	8.24	10.51	11.13	10.54	9.1	8.08	8.11	7.45	7.38	7.8	7.38	11.13	8.76±1.23
Free CO_2 (mgl^{-1})	0.34	0.32	0.2	0.19	0.16	0.18	0.25	0.23	0.33	0.41	0.47	0.52	0.16	0.52	0.30±0.11
Hardness(mgl^{-1})	30.8	37.8	40.2	42.5	43.7	45.6	37.9	34.6	33.9	31.2	30.8	29.7	29.7	45.6	36.56±5.30
Nitrates (mgl^{-1})	0.03	0.07	0.06	0.05	0.03	0.06	0.04	0.05	0.03	0.05	0.06	0.07	0.03	0.07	0.05±0.01
Phosphate (mgl^{-1})	0.06	0.07	0.08	0.09	0.08	1.12	0.09	0.12	0.1	0.11	0.13	0.18	0.06	1.12	0.19±0.28
Sodium (mgl^{-1})	2.87	4.47	3.37	2.79	1.93	3.94	4.98	5.12	4.41	4.76	5.41	5.21	1.93	5.41	4.11±1.08
Potassium (mgl^{-1})	0.92	1.39	1.18	1.46	1.77	1.02	1.21	1.19	0.67	0.97	1.29	0.97	0.67	1.77	1.17±0.28

Table 2: Seasonal variation in physico-chemical parameters of Bharpur stream during September 2013 to August 2014

Parameters	Autumn Sept-Nov	Winter Dec-Feb	Summer Mar-May	Monsoon Jun-Aug
Air Temp.(°C)	17.63±0.42	17.93±1.70	25.74±3.31	22.23±1.24
Water Temp.(°C)	16.27±0.45	14.33±1.43	20.82±1.63	20.07±0.83
Hydro median Depth (m)	0.71±0.02	0.62±0.03	0.55±0.04	0.92±0.18
Velocity(ms^{-1})	0.60±0.05	0.59±0.05	0.60±0.03	0.76±0.03
Transparency (m)	0.53±0.01	0.69±0.02	0.44±0.02	0.33±0.02
Turbidity (NTU)	49.13±8.09	24.50±5.14	35.40±5.90	48.27±14.29
pH	7.52±0.05	7.25±0.03	7.77±0.04	7.84±0.06
Alkalinity(mgl^{-1})	64.70±2.79	51.31±0.72	79.14±8.65	91.79±5.15
TDS (mgl^{-1})	109.53±2.83	101.56±1.19	124.50±8.59	137.17±1.62
D.O. (mgl^{-1})	8.34±0.24	10.73±0.29	8.43±0.47	7.54±0.18
Free CO_2 (mgl^{-1})	0.29±0.06	0.18±0.01	0.27±0.04	0.47±0.04
Hardness(mgl^{-1})	36.27±3.99	43.93±1.28	35.47±1.74	30.57±0.63
Nitrates (mgl^{-1})	0.05±0.02	0.05±0.01	0.04±0.01	0.06±0.01
Phosphate (mgl^{-1})	0.07±0.01	0.43±0.49	0.10±0.01	0.14±0.03
Sodium (mgl^{-1})	3.57±0.67	2.89±0.82	4.84±0.31	5.13±0.27
Potassium (mgl^{-1})	1.16±0.19	1.42±0.31	1.02±0.25	1.08±0.15

Table 3: Pearson correlation between physicochemical parameters

	AT	WT	HMD	VT	Trans	Tu	pH	Alk	TDS	D.O	Free CO_2	Har	Ni	Phos	Na	K
AT	1.000															
WT	**0.921***	1.000														
HMD	-0.123	0.207	1.000													
VT	0.259	0.510	**0.913***	1.000												
Trans	-0.669	**-0.902***	-0.590	-0.769	1.000											
Tu	0.036	0.414	0.681	0.550	-0.712	1.000										
pH	**0.787**	**0.965***	0.422	0.649	-0.981	0.625	1.000									
Alk	0.719	**0.919***	0.575	**0.793***	**-0.992***	0.623	**0.977***	1.000								
TDS (mgl-1)	**0.728**	**0.907***	0.586	**0.825***	-0.972	0.551	**0.954***	**0.994***	1.000							
D.O. (mgl^{-1})	-0.484	-0.783	-0.575	-0.638	**0.940**	**-0.890***	-0.911	-0.888	-0.834	1.000						
Free CO_2 mgl^{-1})	0.334	0.645	**0.878***	**0.940***	-0.905	0.778	0.805	0.893	0.887	-0.859	1.000					
Har	-0.535	-0.821	-0.657	-0.762	**0.982***	-0.832	**-0.942***	**-0.952***	**-0.918***	**0.981***	**-0.928***	1.000				
Ni	-0.371	-0.099	**0.940***	**0.799***	-0.295	0.449	0.107	0.294	0.327	-0.265	0.672	-0.362	1.000			
Phos	-0.428	-0.672	-0.224	-0.237	0.738	-0.829	-0.764	-0.656	-0.568	**0.899***	-0.552	0.801	**0.098***	1.000		
Na	**0.840***	**0.978***	0.407	0.677	-0.964	0.513	**0.987***	**0.981***	**0.975***	-0.841	**0.787***	**-0.899***	0.112	-0.655	1.000	
K	**-0.762***	**-0.924***	-0.205	-0.391	**0.889***	-0.649	-0.945	-0.857	-0.804	**0.904***	-0.634	**0.873***	0.139	**0.903***	**-0.896***	1.000

*Correlation coefficient (r) is significant at the $p<0.001$ level (two – tailed)

Abbreviations: WT: Water temperature, trans: transparency, cond: conductivity, Tu: Turbidity, TDS: Total dissolved solids, pH, DO: Dissolved Oxygen, Alk: Alkalinity, Ca: Calcium, Har: Hardness, Mg: Magnesium, Ni: Nitrates, Phos: Phosphates, Na: Sodium, K: Potassium

MICROGREEN FARMING

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As more people are migrating to cities, the pattern of traditional farming has been changed drastically. As urban populations grow, innovative solutions to feeding all those people are been customized and more innovative practices are been introduced for the production of more food products for the growing population. Most of the urban farmers are also finding low-tech growing techniques still make sense with many crops such as baby greens and microgreens. As the crops can be easily grown indoors, without expensive growing systems and equipment, they are just right for growers on a budget. The Local growers are experimenting with hydroponics, aeroponics, aquaponics and other intensive food production systems, with the goal of providing food that does not need to be shipped long distances.

Microgreens are tiny plants, larger than sprouts, grown to just an inch or two in height, and then harvested. The taste and flavor of microgreens are much more intense than that of full-grown plants, which makes microgreens ideal for garnishes and a tangy, spicy addition to salads and other food preparations .The Microgreens can be grown from the seeds of most salad greens or herbs, but the spicy and colorful plants are most widely grown, such as beets, arugula, mustard, mizuna, kale, radish, endive and tatsoi. Most micro green growers prefer the plastic trays for the cultivation of greens .The selected microgreen seeds are then been soiled and covered with a foil for blackout period .After one or two days,there will be tiny shoots seen in the tray .These are then placed in a well lightened place for the advanced proper growth of the microgreens. When the greens attain appreciable height (normally two weeks of time) the microgreens are been harvested.

The Microgreens are considered as an ideal crop for an urban farm, as there are so many potential customers close by, which helps keep delivery costs low. To assure freshness, most growers harvest a crop in the morning and deliver it to a restaurant the same day, so it is at the peak of freshness when it reaches the plate.

Materials required

- Tray or a container
- Organic seeds
- Spray bottles
- Organic soil or raising a medium rich in nitrogen
- Aluminum Foil or Paper towel
- Plant labels and markers to label the date and variety

Benefits of Microgreens Farming:

- Microgreens are easier to grow and it takes a minimum of two to three weeks for the cultivation of the greens.
- Microgreen varieties can be grown together in a small area. As a reason Microgreens farming is considered to have more yields to space ratio.
- Microgreen cultivation will be a big Yes to the availability of Healthy and organic green food which can be grown in minimum time with very minimum effort and time.
- Most People living in urban settings face the farming or gardening as a big challenge,but Microgreens can cover that problem .
- The minimum requirements for Microgreens farming are simple and it includes water, light and tray for setting up plants and a growing medium.
- The Microgreens are rich in vitamins, minerals and phytonutrients. It also contains living enzymes and nutrients combined by good flavour, colour and texture.
- Microgreens are generally not cooked; they are used as raw greens in food preparations. The use of Microgreens in this way increases the nutrient intake content because there is no loss of nutrients.
- The texture of Microgreens is delicate and crunchy which is why they are used as garnishing agents.

Microgreens can be grown in a very little area than traditional row crops, they have become a popular choice for urban farmers those who have limited growing space. In addition, the added benefit is that the greens have very less growth cycle and a grower can easily produce up to two dozen crops per year. This will in turn maximize the profit.

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ECOLOGICAL INDICATORS

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Abstract:

Indicator species are animals, plants or microorganisms used to monitor changes in our environment. They tell us about the impact of pollution in an ecosystem or how well an impaired environment is being managed or restored. Indicator species can also provide warning signals for upcoming changes of ships to an ecosystem such as climate change. Indicator species serve as sorrow gets to the overall wellbeing of the plant and animal life in a particular environment. In other words conclusion can be drown about an ecosystem by studying an indicator.

Keywords: Indicator species, environment, ecosystem, pollution.

Introduction:

Ecological Indicators are used to communicate information about ecosystem and the impact human activity. Ecological Indicators inform scientist, the public and policy makers about the environmental, social, human health and economic consequences of ever changing ecological conditions. Some indicators reflect conditions at a given in time (e.g. pH, No. of species), while others reflect processes over a given time (e.g. Annual soil erosion, population growth rate etc.). Ecosystems are complex and ecological Indicators can help describe them in simpler terms that can be understood and used by nonscientist to make management decisions.

Ecological Indicators:

Organisms live in environment they are influenced by biotic climatic topographic and edaphic factors. It is commonly observed that plants and animals prefer certain conditions and they grow there better. Plants and animals indicate various things like soil type, temperature, height, pH of soil of the area. That is organisms can function as

ecological Indicators as plants are rooted and fixed, they have to remain in one area. Animals, if conditions are harmful to them can migrate and change the habitat.

A few guidelines would be important in this connection. Species have either narrow tolerance to ecological conditions or they have capability of growing in wide range of conditions. A large species has greater impact of surroundings than a small species therefore large species are better indicators. A species which lives for longer duration functions as better indicator. A community is a better indicator as compared to individual species and interactions among components can be more reliable indicators of surroundings. Numerical relations between species give better indication of conditions of compared to single species. Organisms grow in surroundings but they have capacity of undergoing adaptations to surroundings. This is very commonly observed in euryplastic organisms like weeds and organisms growing in secondary successions.

We shall now consider indicator organisms of some of the ecological conditions.

Platypus – Indicate improving water quality:

Platypus is indicator of pollution they actually serve as indicator of water quality. Platypus is one of the first species to return to water body when the quality starts to improve.

Mollusca/Mussels – Indicate contamination and overall water body health:

They are sessile, fixed in one place and filter feeder. They are extremely sensitive to contamination or to change in the condition of their environment such as temperature, oxygen level and acidity. They assess impacts of anthropogenic and natural events including chemical skills tropical storms and hurricanes.

Grunion:

Grunions are fish found along the Pacific coast of California. They take to land on high tides follow the full moon to take to sand on high tides following the full moon to mate. They lay their eggs at the high tide level and beach serves as a sandy nursery for grunion of eggs and larvae. So it's reproductive cycle is a good indicator of the ecological health of the sandy beaches.

Recide Dace:

It is an endangered fish species they need clean, clear water to thrive as they leap out of the water and eat air based insects. They are an important indicator species for the overall health of a water body.

May flies:

May flies are sensitive to pollution and are considered as Indicator species for the health of fresh water bodies.

Lobsters:

Lobsters have become the face of rising ocean temperatures serving as a climate change Indicators in marine coasts around the world. Rising oceanic temperature, impact oxygen level, salinity, currents and other conditions to which lobsters are sensitive. Hence they are helpful to understand the impact of rising temperatures and changing marine conditions.

Rainbow trout are sensitive to low pH water that inhibits reproductive success, their absence may be an indicator of acidified waters.

Red shiners and speckled dace are habitat of under benign conditions. They found under the harsh conditions in desiccating pools during summer base flow these fishes can be clear Indicators of sever conditions. Some microorganisms also serve as a measure of the environmental conditions that exist in a given locality for example grease wool indicates saline soil, mosses often Indicates acid soil, tubifex worms indicates oxygen poor and stagnant water.

Bacteria-eating protozoans like colpidium, paramaecium and Glaucoma appear. Certain species of fungi, bacteria and animals from large flocs in polluted water due to sewage. Sludge worms, Asiltus and blood worms grow more in polluted water. Movement of fish like Catla, Labeo, Natopterus away from water indicates industrial pollution caused by various effiuents. Hot water is often released as such which causes thermal pollution of water. Aquatic organisms are killed due to it. Release of waste material from sugar, paper and liquor factories causes killing of fish.

Conclusion:

Indicator species, organism—often a microorganism or a plant—that serves as a measure of the environmental conditions that exist in a given locale. For example, greasewood indicates saline soil; mosses often indicate acid soil. Tubifex worms indicate oxygen-poor and stagnant water unfit to drink. The presence of certain species of plants suggests how well other species might grow in the same place.

The ultimate aim of Ecological Indicators is to integrate the monitoring and assessment of ecological and environmental indicators with management practices. The journal will provide a forum for the discussion of the applied scientific development and review of traditional indicator approaches as well as for theoretical, modelling and quantitative applications such as index development.

All aspects of ecological and environmental indicators and indices; New indicators, and new approaches and methods for indicator development, testing and use; Development

and modelling of indices, e.g. application of indicator suites across multiple scales and resources; Analysis and research of resource, system- and scale-specific indicators; Methods for integration of social and other valuation metrics for the production of scientifically rigorous and politically-relevant assessments using indicator-based monitoring and assessment programs; How research indicators can be transformed into direct application for management purposes; Broader assessment objectives and methods, e.g. biodiversity, biological integrity, and sustainability, through the use of indicators; Resource-specific indicators such as landscape, agro-ecosystems, forests, wetlands, etc.

Ecological indicators can be used to assess the condition of the environment, to provide an early warning signal of changes in the environment, or to diagnose the cause of an environmental problem. Ideally the suite of indicators should represent key information about structure, function, and composition of the ecological system. Three concerns hamper the use of ecological indicators as a resource management tool. (1) Monitoring programs often depend on a small number of indicators and fail to consider the full complexity of the ecological system. (2) Choice of ecological indicators is confounded in management programs that have vague long-term goals and objectives. (3) Management and monitoring programs often lack scientific rigor because of their failure to use a defined protocol for identifying ecological indicators.

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BIODIVERSITY CONSERVATION AND SUSTAINABLE DEVELOPMENT

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Biodiversity is being viewed in the condition of sustainable development offers opportunities for poverty control, help in human well-being and the living status and socio-cultural integrity of people and in particular in developing countries which are rich in biodiversity but are poor and stressed to catch up with the globalization challenge and economically stable. Biodiversity constitutes the living natural resources that are found inhabiting our aquatic (including marine and fresh water) and terrestrial (including all the major biomes like forests) ecological systems. Biological diversity is the key international tool to make guarantee the integration of biodiversity-related issues into the Millennium Development Agenda has been examined and underscored. In order to ensure sustainable development, it is necessary to improve the methods of conserve biodiversity and use it sustainably.

Biodiversity is nothing but the biological diversity because variety of life found on Earth. The number of biotic components are present, number of plant species are found, animals, and microorganisms, the enormous diversity of genes in these species, the different ecosystems on the planet, such as deserts, terrestrial, evergreen forest, rainforests and coral reefs are all part of a biologically diverse Earth[1]. Appropriate conservation and sustainable development strategies attempt to be responsive of this as being essential to any approach to preserving biodiversity. Almost all cultures have their origin in our biological diversity in some way or form. Biodiversity boosts ecosystem productivity where each species, no matter how small, all have an important role to play for example, a larger number of plant species means a greater variety of crops and greater species diversity ensures natural sustainability for all life forms. Healthy ecosystems can better survive and get better from a variety of disasters and so, while we dominate this planet, we still need to preserve the diversity in wildlife. Isn't it interesting to just know that you share this

world with millions of other species? Biodiversity further classifies into three major types. They are as follows.

1. Genetic diversity:

It is primarily the variety of species expressed at the genetic level by each individual in a species. A single species are also shows high diversity at genetic level. No two individuals belonging to the same species are exactly similar genetically for example, in plant two verities of same genus having different species depends on their genetic constitution, in the species of human beings, each human shows a lot of diversity in comparison to another human[2]. People living in different regions show a great level of variation. Like animal plants also have genetic variation in same species. The genetic variation showed by medicinal plants which are essential for human welfare. India has more than 50000 genetically different strains of rice and 1000 variety of mango. This genetic variation expresses the characteristic features of living organisms.

Importance of genetic diversity:

- Genetic diversity gives rise to different physical attributes or external appearance to the individual and capacity to adapt, to stress, diseases and unfavorable environmental conditions. So because of adaptations different ecosystems are found in environment.
- Now a day lots of environmental changes are seen that are natural or due to human involvement, show the way to the natural selection and survival of the fittest. Hence, due to genetic diversity, the varieties of plants as well as animals that are vulnera Clement[1] able, die and the ones who can adapt to changes will survive.
- Genetic diversity is important for a healthy population by maintaining different varieties of genes that have capacity to be resistant to pests, diseases or other conditions.
- New techniques are developed for adaptation of environment at genetic level and with the help of these varieties of plants can be grown by cross-breeding different genetic variants and produce plants with desirable traits like disease resistance, increased tolerance to stress.
- Genetic diversity reduces the duplication of undesirable inherited traits.
- Genetic diversity ensures that at least there are some survivors of a species left.

2. Species Diversity:

It is the biodiversity observed within a community. It stands for the number and distribution of plants and animal species for example the Western Ghat

have a greater amphibian species diversity than Eastern Ghat[3]. The number of species in a region varies widely depending upon the varied environmental conditions and make different community for organism example, it is usually observed that civilizations residing beside water bodies show more species than the one compared to the areas away from water bodies. Like animals and human plant species are also more near the water bodies and develop variety of ecosystems.

Importance of Species Diversity:

- In a healthy ecosystem, diverse and specific number of species exist to maintain the balance of an ecosystem. In an ecosystem, all the species depend on each other directly or indirectly. So to make a more efficient, productive and sustainable ecosystem, it is important to maintain high species diversity[4].
- Large number of diverse species in ecosystem tends to be more useful. e.g. the ecosystem with a great variety of producer species will produce large biomass to maintain a greater variety of user species. Superior species wealth and production makes an ecosystem more sustainable and stable
- The ability to withstand environmental stresses like lack or persistent huge number depends on more diverse the ecosystem.
- Species richness makes an ecosystem able to respond to any disaster. In species-rich communities, each species can use a different part of resources available as per their condition. e.g. plants with smaller roots can absorb water and minerals from shallow soil and plants with deeper roots can tap deeper soil. Rich diversity is important for the survival of mankind.
- Healthy biodiversity has countless benefits like nutrients storage and recycling, soil development and protection from erosion, absorption of harmful gases, climate stability
- Humans get lots of product from nature like fruits, cereals, meat, wood, fiber, raisin, dyes, medicine and antibiotics. Pollinators, symbiotic relationships, decomposers, each species perform a unique role, which is unique variety of species.
- Varieties in large numbers help in large scale communication among organisms such as in the food web. In the nitrogen cycle, bacteria, plants have a essential relationship, earthworms contribute to soil fertility. Apart from these, there are other benefits such as recreation and tourism, education and research

3. Ecological Diversity:

At ecosystem level the diversity observed among the ecosystems in a particular region. Different ecosystems like mangroves, rainforests, deserts etc show a great variety of life forms residing in them[5].

It has taken millions of years of evolution, to accumulate this rich diversity in nature.Without the proper conservation of this diversity; we could end up in different unstable situations. So its need to conserve biodiversity. Biodiversity and its conservation are now vital environmental issue. Biodiversity conservation refers to the protection, survival, and management of biodiversity in order to derive sustainable benefits for present and future generations.

Objectives of Biodiversity Conservation:

- To preserve and improve the diversity of species.
- Sustainable utilization of species and ecosystem.
- To maintain life-supporting systems, natural resources and essential ecological processes.

Biodiversity Conservation Methods:

When we conserve and protect whole ecosystem, its biodiversity at all level is protected. we save the entire forest automatically the animal species are also protected. Biodiversity refers to the inequality of life on earth. It can be conserved in the following ways

- *In-situ* Conservation
- *Ex-situ* Conservation

***In-situ* Conservation:**

In-situ conservation of biodiversity is the conservation of species within their natural habitat. In this method, the natural ecosystem is maintained and protected (Johnson *et al.,* 2020).The in-situ conservation has several advantages and disadvantages. For protection of species diversity "biodiversity hotspots" are developed and protects. Initially 25 biodiversity hotspots were identified but nine more hotspots are added. These hotpots are help to accelerate habitat loss. Following are the important advantages of in-situ conservation:

1. In-situ method of biodiversity conservation is a cost-effective because of low cost and a easy method for conserving biodiversity.

2. At time large number of living organisms can be conserved simultaneously.
3. In this method the organisms are in a natural ecosystem, they can evolve easily in ecosystem and food chain for better biodiversity and can easily adjust to different environmental conditions.

In India, ecologically unique and biodiversity rich regions are protected. These protected areas where in-situ conservation takes place include national parks, wildlife sanctuaries and biosphere reserves[6].

National Parks:

In India 90 national parks were help to conserve biodiversity by in-situ method.These are small reserves maintained by the government. It has restrictions for well demarcate and human activities such as grazing, forestry, habitat and cultivation are prohibited. For eg., Kanha National Park, Bandipur National Park.

Wildlife Sanctuaries:

In India 448 wildlife sanctuaries which protect biodiversity. Many forest were set a side for biodiversity protection. Aravalli hills of Rajasthan, Hill in Meghalaya, Western Ghat and Maharashtra are some example of wildlife sanctuaries. These are the regions where only wild animals are found. Human activities such as timber harvesting, cultivation, collection of woods and other forest products are allowed here as long as they do not interfere with the conservation project. Also, tourists visit these places for recreation.

Biosphere Reserves:

India now has 14 biosphere reserves. India has also a history of religious and cultural tradition for protection of nature. Biosphere-reserves are multi-use protected areas where the wildlife, traditional lifestyle of the population and cultivated plants and animals are protected[7]. Tourist and research activities are permitted here.

***Ex-situ* Conservation:**

Ex-situ conservation of biodiversity involves the animals and plants are taken from their natural habitat and placed in special setting where they can protected and given special care. It also involves breeding and maintenance of endangered species in artificial ecosystems such as zoological park, nurseries, botanical gardens, gene banks, etc. For the conservation o biodiversity government provide funds so there is less competition for food, water and space among the organisms.

Botanical Gardens:

Botanical Gardens are developed for protection of commercially important plants and research based endangered species. It may contain specialist plant collection. Botanical

gardens specially run by institution or organizations. For the protection of biodiversity mainly two initiatives are involves that is the Global Taxonomy Initiative (GTI) and Global Strategy for Plant Conservation (GSPC) which have been established by the Convention on Biological Diversity for specific purposes. GTI is support for decision making in conservation of biological diversity by addressing the deficient in of taxonomic in sequence on the identity of mechanism of biological diversity in many parts of the world, and the need to build ability for taxonomic activity in all regions. Main objectives of the Convention on Biological Diversity is to conserve unique species of plants and animal. GSPC is provide a structure for policy on 16 action-oriented targets for plant conservation in the areas of understanding and documenting plant diversity, conserving plant diversity, using plant diversity sustainably, promoting education and awareness about plant diversity and building capacity for the conservation of plant diversity.

Ex-situ conservation has the following advantages[8]:

1. This method involves the plants and animals. In which animals are provided with a longer time and breeding activity.
2. Those species are bred in captivity can be reintroduced in the wild and protects them and help for sustainable developments.
3. Now a day many techniques were introduced in biodiversity conservation.New combinations of gene are made in organisms with the help of this techniques. Genetic techniques can be used for the preservation of endangered species and their unique characters.

Strategies for Biodiversity Conservation:

Following are the important strategies for biodiversity conservation:

- All the varieties of food, timber plants, livestock, microbes and agricultural animals should be conserved.
- All the economically important organisms should be identified, protect and conserved.
- Useful and unique ecosystems should be preserved first.
- Natural resources should be utilized efficiently.
- Poaching and hunting of wild animals should be prevented.
- The reserves and protected areas should be developed carefully.
- Man made pollutants level should be reduced in the environment and to maintain healthy environment for organisms.

- Tree plantation should be compulsory and deforestation should be strictly prohibited.
- Add new strategies in environmental laws and law should be followed strictly.
- Endangered species of plants and animals should be protect and conserved in their nature as well as artificial habitats.
- Public awareness play an important role in conservation so awareness should be created regarding biodiversity conservation and its importance.

It is understood that an area with higher species large quantity has a more stable environment compared to an area with lower species abundance[9]. We can further maintain the necessity of biodiversity by taking into consideration our degree of dependency on the environment. We depend directly on various species of plant for our various needs. Similarly, we depend on various species of animals and microbes for food and medicines[10].

Biodiversity is being lost due to the loss of habitat, over- use of resources, climatic changes, pollution, invasive exotic species, diseases, hunting, etc. Since it provides us with several economic, social and ethical benefits and adds visual value, it is very important to conserve biodiversity[11].

Biodiversity provides a number of natural services for sustainable development[12]:

- Ecosystem services, such as
    - Protection of water resources
    - Soils formation and protection
    - Nutrient storage and recycling
    - Pollution breakdown and absorption
    - Contribution to climate stability
    - Maintenance of ecosystems
    - Recovery from changeable events
- Biological resources, such as
    - Food and shelter
    - Medicinal resources and pharmaceutical drugs
    - Wood products
    - Ornamental plants
    - Breeding stocks, population reservoirs
    - Future resources
    - Diversity in genes, species and ecosystems
- Social benefits, such as

- Research, education and monitoring
- Recreation and tourism

Conclusion:

These are some important services we get for free from healthy biodiversity. The cost of replacing these services would be extremely expensive. It therefore makes economic and development sense to move towards sustainability. All these diversities help in maintaining the proper balance of nature. But from few years, there has been a major loss in the biodiversity across the globe. The loss of biodiversity could harmfully affect our environment as the balance is lost and the natural food web is disturbed. Due to its major role in our survival, conservation of biodiversity has now become a matter of high priority. Everybody is paying high attention to it. There are number of species we still have not identified all the species living on the earth but of all the ones identified till now, many have already been marked as extinct .Recently, the rate of extinction has gone high and this is causing direct impact on our earth like over use of resources in some parts, the over population of some species, etc. This has created a great imbalance in nature. Now its time to understand the importance of biodiversity. We must take essential actions to maintain biodiversity for sustainable development. The long term point of view for sustainable development requires the transmit participation of various stakeholders in policy formulation, management and implementation at all levels in particular of issues of biological diversity and this must be encouraged. The Botanic Gardens Conservation International, and other similar institutions, are considered as having major roles to play including to inform and educate their constituents on the belief of biological diversity to sustainable development.

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SPATIO - TEMPORAL DEVIATION OF PRECIPITATION DATA IN DIFFERENT ZONES OF SANGLI DISTRICT

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Introduction:

Water is the significant source to every living thing, without water living things are does not endurance on the earth surface. More than 70% individuals in India are busy in farming area and this area was absolutely relying upon the water or water system rehearses. Precipitation is the best pointer to show the agronomic advancement of the well known fact is the place where higher the precipitation higher the agronomic creation. The issue of raising sufficient nourishment for millions is of critical significance. Indian economy is totally related with the rainstorm and its success is completely reliant on measure of precipitation get during storm season. The achievement or disappointment of yields at whatever year is methodicallly related with the conduct of the storm greatest conditions of India get 90 to 95 percent downpour from south-west rainstorm. Genuine usage of water assets is of prime significance to increment agronomic creation. The precipitation varieties are generally a result of alleviation varieties, contracted conditions, development of the storm through climatic condition and accessibility of plants. Precipitation in most of India is uncertain, lopsided and inconsistent circulated. Temperature and Rainfall is the tremendous boundaries which influencing farming movement of man.

The Irrigation Commission 1972 has familiar 67 drought prone districts approval of 326 Tahsils located in 8 states. Commission on Agriculture, 1976, documented a few more drought prone areas with slightly different norms. The Drought Area Study and Investigation Organization of C.W.C. set up in 1978 started with 99 districts after considering the list of districts identified by the Irrigation Commission and also by the National Commission on Agriculture for carrying out further studies. For the studies,

C.W.C. adopted the same criteria as followed by the Irrigation commission 1972. The drought is occurring in an area: 1) when the annual rainfall is less than 75% of the normal in 20% of the years examined. 2) Less than 30% of the cultivated area is irrigated. CWC adopted a smaller unit viz. Tehsils for drought identification studies instead of districts and therefore, number of drought affected Tehsilswere identified as 315 out of a total of 725 Tehsils in 99 districts. Accordingly out of 108 M. ha. area of 99 districts, only 51.12 M.ha. Spread over 74 districts has been considered as drought districts. Thus, in contrast to over-all geographical area of the country (329 M.ha) about 1/6th area is drought prone. Irrigation is the most effective drought proofing mechanism. The total geographical area of the drought districts is 108 M.ha, out of which 81 M.ha. is culturable (75%), gross sown area is 61.9 M.ha. (57.4%) and the gross irrigated area is 4.3 M.ha. About 23.23% of the total cropped area is irrigated in the drought districts as against in all India average of 30.15%.

Rainfall is the ultimate significant natural hydrologic event and is a unique phenomenon varying both in space and time. The rainfall distribution is very uneven and it not only varied considerably from place to place but also fluctuates from year to year. The rainfall play vital role in planning and operation strategies of any agricultural programme for any area. Indian subcontinent gets around 75% of the annual rainfall during monsoon period, which lasts from June to September i.e. four months. The major water requirement of the country is fulfilled by rainfall, which occurs in the monsoon period. There is large variation in distribution of rainfall from year to year. In present study, the rainfall data since 1983 is used to investigate drought prone tehsils of Sangli district.

The purpose of this project is to illustrate the pretreatment process of weather-related data, demonstrate the application of different copulas to modeling of joint distributions of rainfall and temperature, select the most suitable copula function according to information criteria, and finally simulate rainfall and temperature simultaneously.

Geographical Information of Sangli District:

Sangli district falls partly in Krishna and Bhima basin. Consequently, Sangli district is divided into different drain systems. The whole district can be divided into three different parts depends on topography, climatology and rainfall viz.

1. **WesternZone /** hilly area of Shirala tehsil with heavy rainfall.
2. **Central Zone /** basin area of Krishna, Warna&Yerala rivers, comprising of Walwa, tehsil & western part of Tasgaon and Miraj tehsils with medium rainfall.

3. **Eastern Zone** / drought prone area which comprises of eastern part of Miraj, north-eastern part of Khanapurtehsil and Tasgaon tehsils, and whole of Atpadi, KavatheMahankal and Jath tehsils.

The climate gets warmer and drier towards the east and humidity goes on growing towards the west. The maximum temperature is 42º C while the minimum temperature is 14º C. The climate in the district is fairly tolerable throughout the year. The winter is pleasant from December to February. The summer season starts from mid-February to May. June to September is the months of normal rainy season. July and August are the months of heavy rainfall. The average rainfall of Sangli district is 400-450 mm per year.

The purpose of present study is to investigate the variations in the rainfall in different seasons of Sangli district by detecting the precipitation changes in the temporal and spatial structure for the period 1989to 2019. The present project consists of five sections. The first section introduces the paper and objects of the work. The second section deals with Reviewof literature with special reference to trends in rainfall data. The third section describes study area, methodology and statistical techniques used for analysis. The fourth section discusses results and its discussion while the fifth one outlines concluding remarks.

Review of Literature:

Climatic studies aim to identify and regulate the climatic changes in various perspectives. Here, we proceedtransient review of some of the research studies supplemented in the context of trend analysis of Indian monsoon rainfall information. Timeseries of annual rainfall, number of rainy-days per year and monthly rainfall of 10 stations were analyzed by Zende *et al.*[1] to evaluate climate variability in semiarid region of Western Maharashtra. They have reported that results showed mixed trends of increasing and decreasing rainfall, which were statistically significant only for Koregaon and Palus stations by the Mann–Kendall test. Also, with the exemption of Vita and Vaduj stations there was no statistically significant trend in the mean number of rainy-days per year. Accumulative and reducing monthly rainfall trends were found over large continuous areas in the study region. These trends were statistically noteworthy mostly during the winter and spring seasons, signifying a seasonal movement of rainfall concentration. Results also showed that there is no significant climate variability in the semi-arid environment of Western Maharashtra. Kumar and Jain[2] have piloted study to determine trends in annual and seasonal rainfall and rainy days over different river basins across India. Among 22 basins studied by them, 15 showed a decreasing trend in annual rainfall; only one basin

showed a significant decreasing trend at 95% confidence level. Most of the basins have shown the same direction of trend in rainfall and rainy days at the annual and seasonal scale. Rainfall is subject to strong seasonality in tropical monsoonal climate. Kumar *et al.*[3] studied monthly, seasonal and annual trends of rainfall using monthly data series of 135 years (1871 to 2005) for 30 sub-divisions (sub-regions) in India. Half of the sub-divisions showed an increasing trend in annual rainfall, but for only three (Haryana, Punjab and Coastal Karnataka), this inclination was statistically significant. Similarly, only one sub-division (Chhattisgarh) designated a significant decreasing trend out of the 15 sub-divisions showing decreasing trend in annual rainfall. They have also reported that during June and July, the number of sub-divisions showing increasing rainfall is almost equal to those showing decreasing rainfall. There are spatial and temporal variations in various attributes of the rainy season such as starting date, ending date, durability, etc. Numerous notions of rainy season exist in the real world and the literature, e.g. green season, growing season, wet season, monsoonal rainy season and wet period. Krishnakumar *et al.*[4] have studied temporal variation in monthly, seasonal and annual rainfall over Kerala, during the period from 1871 to 2005. Their analysis discovered significant decrease in southwest monsoon rainfall while increase in post-monsoon season over the State of Kerala which is usually known as the 'Gateway of summer monsoon'. According to Ranade *et al.*[5], a hydrological wet season by taking theconcernofimportant parameters such as initial and windup dates and duration, seasonal rainfall/rainwater and surplus rainfall/rainwater potential. They have performed analysis for the 11 major and 36 minor rivers basins as well as the West Coast Drainage System and the whole country using highly quality-controlled monthly rainfall from well spread network of 316 rain-gauge stations from earliest available year up to 2006 and observed declining tendency in the rainfall/rainwater and surplus rainfall over most of the minor basins. The state-wise analyses of rainfall have also been reported in the literature. As it can be seen from the above survey, previous studies have been conducted either river basin wise or state-wise. None of the study deals with month-wise and/or meteorological region-wise analysis of Indian rainfall data. Shesabhare and Kalange[6] have studied the trends in the time series of rainfall data for more than 100 years. They have reported the results of the trends monsoon month-wise as well as meteorological region-wise. As far as Indian economy is concerned, district is considered as smallest unit of the nation and accordingly policies are worked out. Thus, geographical location like district is playing a crucial role in the design of policy. This aspect along with others motivated us to undertake the study of rainfall with study area limited to Sangli district. Accordingto Pore *et al.*[7], Rainfall data is of great importance of any agricultural and non-agricultural

programme. If appropriate and broad study of various rainfall data was assessed, the harshness and reoccurrence of drought can be forecast and various measures can be taken to cope up with the problems arising due to drought. In 2019, Wagmare and Wagmare study impacts of rainfall changeability of yields of main crops and investigate the benefits of rainwater harvesting as a livelihood policy.

Methodology:

Material and Methods:

The data used for this study is secondary data. The data is obtained from the Indian Meteorological Department, Pune and Mahakrushi website. The data comprise the records of actual rainfall recorded at three tehsils in Sangli district. The rainfall records include observations spanning from 1983 to 2019 and cover a period over 37 years. For the said purpose the period of time series is long enough to carry out statistical analysis. As many hydrological time series data are not normally distributed, non-parametric tests were preferred over parametric tests. The methodology adopted for the study was designed as per the previous work in this area[6, 8].

Study area:

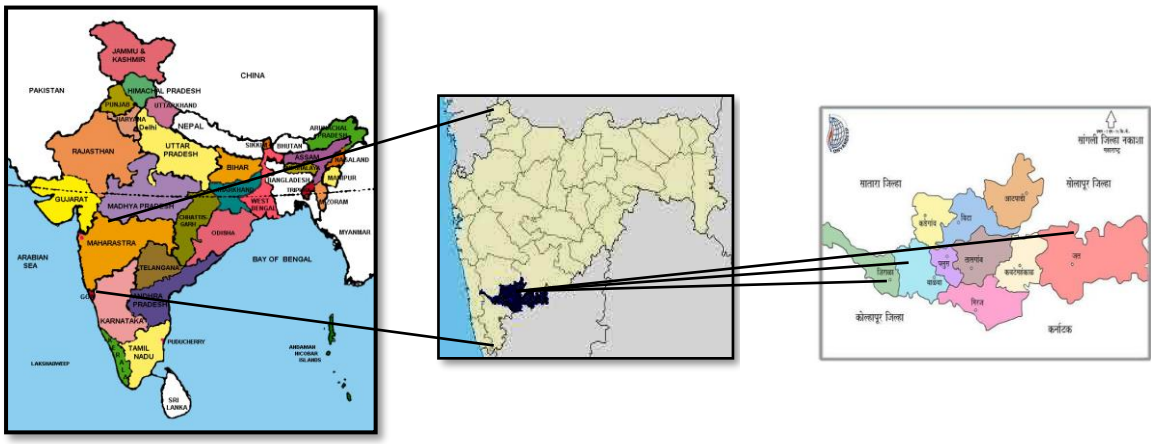

Figure 1: Location of Study Area

The present study is focused on Rainfall drifts in Sangli district of Maharashtra state. The Sangli district lies between 16^0 45'and $70^0$33'north longitudes and 73^0 42' and 75^0 40' east latitudes. The district is divided in to 10 tehsils with an area of 8591.3 kilometers and a population near about 2825000. Geographically the district is divided into three zones, viz. western zone, central zone and eastern zone. The district lies in the Sothern part

of Maharashtra state. This study is conducted considering three tehsils of Sangli district as a study area.

1. Shirala Tehsil **from Western Zone** with heavy rainfall.
2. Walawa – Islampur Tehsil from **Central Zone**with medium rainfall.
3. Jath Tehsil from **Eastern Zone**withdrought prone is selected as representative of three zones of Sangli District.

Note: Data used: All the tehsils of Sangli district collected monthly rainfall data from normal months from 1981 to 2019 (48) and use dry observation cells to inspect from Drought Monitoring Cell Bangalore and IITM-IMD Rainfall.

Results and Discussion:

Average rainfall fluctuation of three selected tehsil of Sangli district are represented in Fig.2

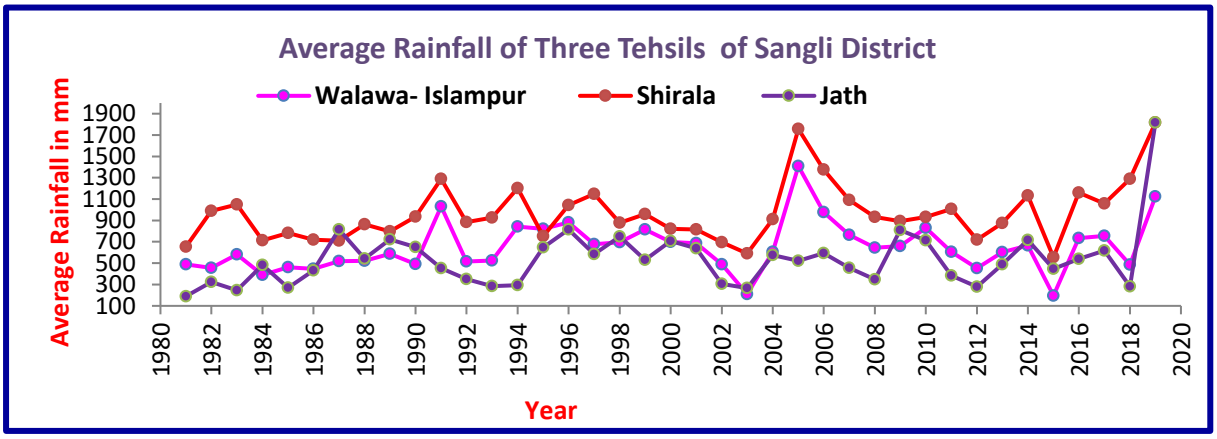

Figure 2: Variability of rainfall for three tehsils of Sangli district (1981-2019)

It is marked that the annual rainfall among the zones under consideration could best be described as oscillatory. The trend is not regular but irregular. However comparing the three tehsils, it can be observed that the Walawa - Islampur tehsil trend is more regular than the other. Additionally, the Shirala tehsil has the highest oscillatory trend of rainfall. The higher precipitation recorded in the Shiralatehsilgenerally could be credited to the mountainous nature of the area, coupled with thick forests and also the Warana River and VasantSagar Dam which supply the bulk of the atmospheric moisture for precipitation. The low rainfall at Jath tehsil could be attributed to the vegetationless nature of the area. The loss of vegetation in these areas, compared to that of forest and mountainous areas, reduces natural cooling provided by evapotranspiration, the process through which

intercepted radiation is utilized by plants, soils, and water bodies to convert water to water vapour[9]. This water vaporincreases to the upper atmosphere, condenses, and eventually falls as rain. However other studies averred that since rainfall in the tropics is extremely variable in both space and time, identifying the precise cause of fluctuations remains problematic[10, 11].

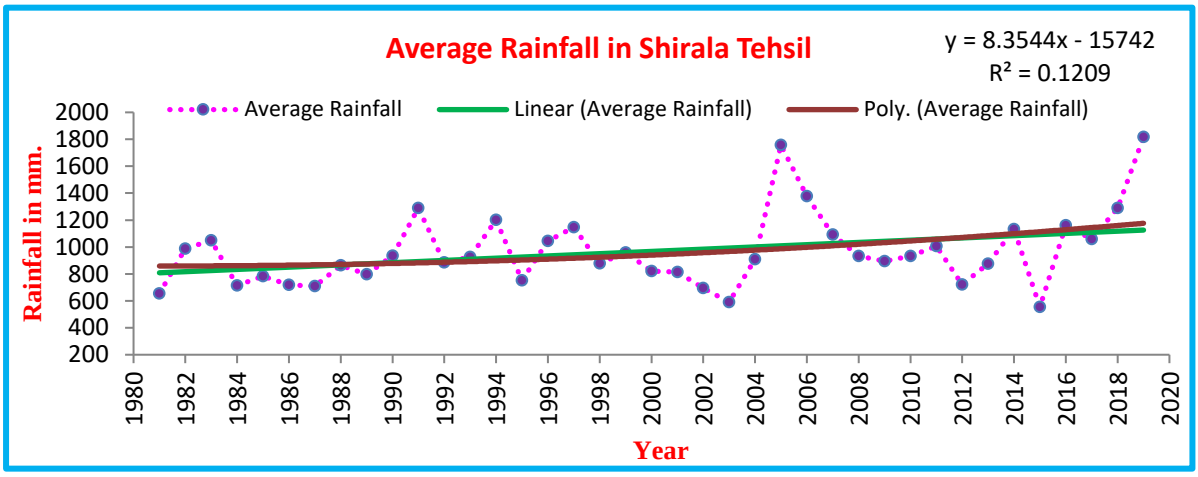

Figure 3: Average and polynomial multi-curve of annual rainfall for Shirala Tehsil

Western Zone / hilly area of Sangli district represented by Shirala tehsil with heavy rainfall. Shirala Tehsil (Fig. 3) shows a decline in general migration at a rate of -26.20 mm per year. Multiple bend patterns decreased from 1981 to 1991, and bend patterns increased from1990. The redirection pattern declined slightly between 1998 and 2003, indicating that low rainfall could last for up to four years. In 2005 and 2018 it shows the highest rainfall and it is upto 1750-1800mm.The years 1981, 1984- 1988, 2000 to 2004, 2008 to 2013, 2015 and 2017 this region suffers from drought conditions while year 1987, 1989, 1992 to 1994, 2007, 2014 and 2015 show average rainfall.

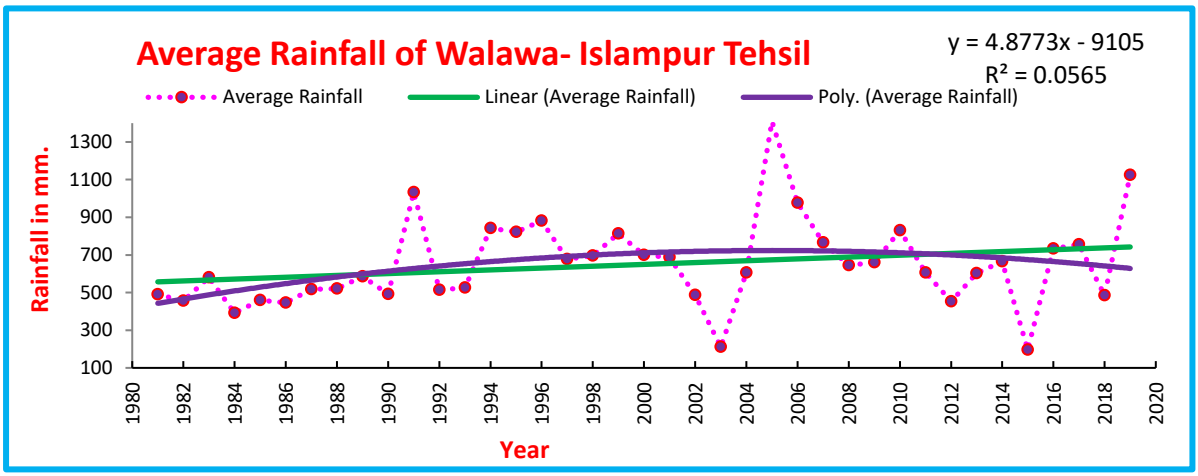

Figure 4: Average and polynomial multi-curve of annual rainfall for Walawa-IslampurTehsil

Walawa – Islampur Tehsil represents Central Zone with medium rainfall in Sangli District. It shows minimum rainfall from 1981to1990 as well as from 2000 to 2004 and from 2008 to 2016 than the average rainfall. It shows same pattern as like Shirala Tehsil. In year 1991, 2005and 2019 it shows heavy rainfall. The highest rainfall occurs in year 2005 causes flood situation. In this region drought condition was observed during the years from 1981, 1982, 1984 to 1990,2002to 2004,2008 to 2015 and 2018. While in year 1983, 1989,1997,1998,2000,2001,2007, 2016 and 2017average rainfall was observed

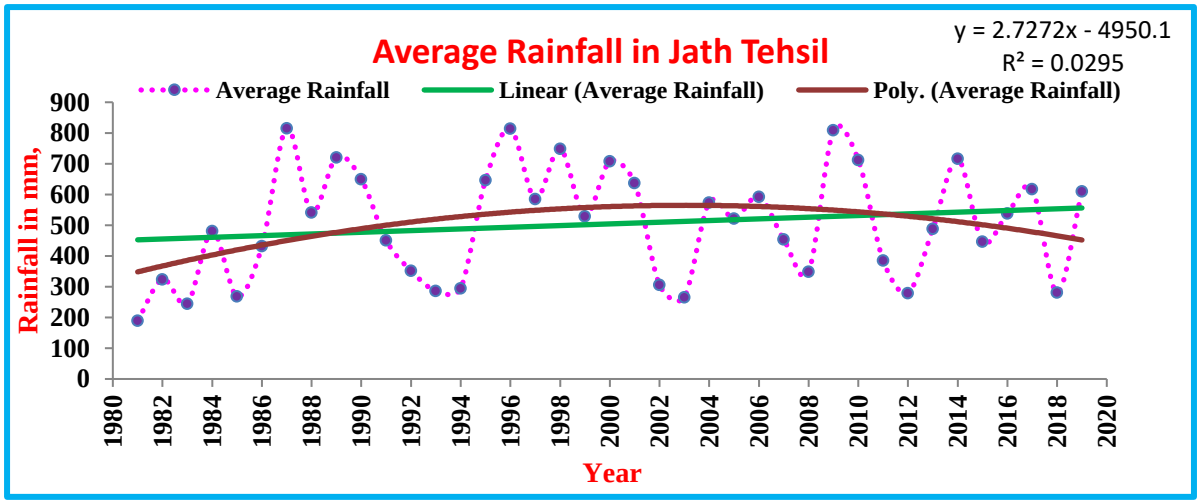

Figure 5: Average and polynomial multi-curve of annual rainfall for JathTehsil

Jath Tehsil from Eastern Zoneis with drought prone region. The average rainfall of this region is observed in 1984, 1991, 1999, 2005 and 2016 years. During 1981 to 1983, 1985, 1986, 1991 to 1994, 2002, 2003, 2005, 2007, 2008, 2011 to 2013, 2015 and 2018 rainfall decreases than average rainfall hence that region suffers from drought conditions. While years from 1987 to1990, 1995 to 1998, 2000, 2001, 2004, 2006, 2009, 2010, 2014, 2017 and 2019 show maximum rainfall than average rainfall. The highest rainfall occurs in year 1887 and 2009. It was about 809 to 815 mm.

Table 1: Linear Regression statistic results for annual rainfall for three tehsils of Sangli District.

Sr. No.	Tehsil	Regression equationy	*R*-square	Statistically significant
1	Shirala	8.3544x - 15742	0.1209	No
2	Walawa- Islampur	4.8773x - 9105	0.0565	No
3	Jath	2.7272x - 4950.1	0.0295	No

Linear regression is one of the simplest methods to calculate the trend of data in time series. The equation of linear regression line is given by$Y = a + bX$, where X is the independent variable and Yis the dependent variable. The slope line is b and a is the intercept (value of Y when X=0). The slope of regression describes the trend whether positive or negative. In this study dependent variable Y is rainfall and independent variable X is year. Linear regression requires the assumption of normal distribution. In this study, the null hypothesis is that the slope of the line is zero or there is no trend in the data. The value of R-square (R^2) or the square of the correlation from the regression analysis was used to show how strong the correlation and relationship between the variables X and Y are. The value is a fraction between 0.0 and 1.0. The R^2 value of 1.0 means that the correlation becomes strong and all points lie on a straight line. On the other hand, an R^2 value of 0.0 means that there is no correlation and no linear relationship between X and Y

The results of the linear regression trend analysis are presented in Table 1, respectively, covering Shirala, Walawa- Islampur and Jath tehsils respectively, of the Sangli District. In these trend tests, trend of annual rainfall for 40 years has been computed for each independently. The linear trend lines of the annual rainfall indicated a downward trend and annual rainfall data for the Shirala Tehsil. That means there is no statistically significant trend in the annual and monthly rainfall data for northern zone. Additionally, the R-square statistic also indicated a very weak relationship between the variables, rainfall, and year.

Conclusion:

The study has represented a comprehensive breakdown of rainfallvariability and trend of rainfall in Sangli and Satara districts. The area inthe eastern part of the Sanglireceiving very lessrainfall compare to the other parts of the district. By using 35 years recodedof rainfall in both the district, the study scrutinized the temporal and spatialvariation of rainfall on a western, central and eastern part of the study area.These results also indicated that for the analyzed time-period, there was no significant climate change in the study area. The results also suggest the need for further investigation on local environmental issues, which could be one of the major causes of climate change. The main recordings of the study are summarized below.

1. Annual rainfall in the Sangli district varies from year to year.

2. Trend analysis of annual average rainfall indicators shows fluctuations in 35 years.During the period of, 1982, 1983, 1986, 1987, 1995, 2000,2001showsdecreasing trends in Sangli district.

3. Coefficient of variation in Sangli district was 17.37.

The key focus in this study has been to understand rainfallvariability as a basis for improving the understanding of crop to climateinteractions in study region. We analyze impacts of rainfall variability ofyields of staple crops and investigate the benefits of rainwater harvestingas a livelihood approach. In conclusion, this study has shown thatthere are significant intra-regional alterations in rainfall amount,irregularity and trend. In general, rainfall amount is higher and itsvariability lower, in the western part of the region than in the eastern part.The observed trends in some of the results are thus mainly dependent on local scale climatic controls, rather than large scale climatic making. Theresults also suggest the need for further investigation local anthropogenicintervention in the environment, which could be one of the major causesof climate change in study regions.

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BASIC EXPERIMENTAL APPROACHES IN ALLELOPATHIC STUDIES

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Allelopathy a reality:

Weeds are very common, dominant and spread in any crop field. They propagatequickly like wildfire and grow abundantly in crop fields and harm the main crop. Weeds are unwanted, undesirable and common plants that compete with cropplants for water, nutrients and sunlight. Some weeds interfere with crop plants through exudes - allelochemicals, which reduce the crop growth and crop development .So, weeds directly reduce yield or profits by harvesting operation or period. They often reduce the crop quality and weeds which are left , grow in an uncontrolled way often attracting many different insects and diseases that produce the seed or rootstocks which later effect the future crops. Some weeds have a stimulatory effect on the crop plant. The weeds produce a wide variety of secondary metabolites called as allelochemicals and this chemical s are responsible for the growth of other plant species; this phenomenon is known as allelopathy. Allelopathy is defined as the direct harmful or beneficial effect of one plant on another through the production of chemical compounds that escape into the environment. Therefore the urgent need to study unwanted plants in the crop fields. Allelopathy is an interference mechanism, in which live or dead plant materials release chemical substances, which inhibit or stimulate the associated plant growth (Harper, 1977; Dhavan andNarwal, 1994). Allelopathy may also play an eminent role in the intraspecific and interspecific competition and may determine the type of interspecific association. The plant may exhibit inhibitory or rarely stimulatory effects on germination and growth of other plants in the immediate vicinity.

Society defined allelopathy as follows: “Any process involving secondary metabolites produced by plants, micro-organisms, viruses, and fungi that influence the growth and development of agricultural and biological systems (excluding animals), including positive

and negative effects" (Torres *et al.,* 1996). Allelopathic interactions between plants have been studied in both managed and natural ecosystems. In agricultural systems allelopathy can be part of the interference between crops and between crops and weeds and may therefore affect the economical outcome of the plant production. Both crop and weed species with allelopathic activity are known (Inderjit and Dakshini, 1998, Inderjit and Foy, 1999, Putnam and Weston 1985, Weston, 1996). Allelopathic chemicals can be present in any part of the plant. They can be found in leaves, flowers, roots, fruits, or stems. They can also be found in the surrounding soil. Target species are affected by these toxins in many different ways. The toxic chemicals may inhibit shoot/root growth, they may inhibit nutrient uptake, or they may attack a naturally occurring symbiotic relationship thereby destroying the plant's usable source of a nutrient.In the recent years, creating competition between native and alien species has gained momentum. Numerous plants are reported to possess allelopathic potential and effort has been made to use them in weed control

In a survey conducted on the diversity of ruderal vegetation in and around Mumbai showed that in the vicinity of several plants no plants were present or very few plant species were able to survive. Some of the plants are *Hyptis sauveolens, Ricicnus communis, Eclipta alba, Eupatorium sps, Alternanthera sessilis, Ipomoea carnea, Cymbopogon citrutus, Wedelliasps* etc. on waste lands and barren patches of land the locals in the area cultivated crops after the rainy season or during the monsoon by harvesting the plots of weeds present in such areas (Joshi, 1990).

The findings of Allelopathy research can be used by the government authorities for planning the future development strategy and the allocations of funds can also be decided depending upon these findings. The Researchers in the subject of Economics can use the results of this study for their studies in the subject. From the agronomic point of view, the research in allelopathy provides perspectives of a reduced reliance on traditional herbicides if weed control can be achieved by the release of allelochemicals from the crop. Also, in cropping systems where herbicides are not used, for example in organic farming, crop cultivars with enhanced allelopathic activity could be part of the weed management strategy. Weed control mediated by allelopathy - either as natural herbicides or through the release of allelopathic compounds from a living crop cultivar or from plant residues - is often assumed to be advantageous for the environment compared to traditional herbicides

The basic approach used in allelopathic research for agricultural crops has been to screen both crop plants and natural vegetation for their capacity to suppress weeds. To demonstrate allelopathy, plant origin, production, and identification of allelochemicals must be established as well as persistence in the environment over time in concentrations

sufficient to affect plant species. In the laboratory, plant extracts and leachates are commonly screened for their effects on seed germination with further isolation and identification of allelochemicals from greenhouse tests and field soil, confirming laboratory results. Interactions among allelopathic plants, host crops and other non-target organisms must also be considered. Furthermore, allelochemistry may provide basic structures or templates for developing new synthetic herbicides. Incorporation of allelopathic traits from wild or cultivated plants into crop plants through traditional breeding or genetic engineering methods could also enhance the biosynthesis and release of allelochemicals.

An allelopathic crop can potentially be used to control weeds by planting a variety with allelopathic qualities, either as a smother crop, in a rotational sequence, or when left as a residue or mulch, especially in low-till systems, to control subsequent weed growth. Alternatively, application of allelopathic compounds before, along with, or after synthetic herbicides could increase the overall effect of both materials, thereby reducing application rates of synthetic herbicides.

Review of International status:

Recently, several papers have suggested that allelopathy holds great prospects for finding alternative strategies for weed management. Thereby, the reliance on traditional herbicides in crop production can be reduced (Macias *et al.,* 1997, and Wu *et al.,*1999). Today, the allelopathic activity of some crops, for example rye, is to some extent used in weed management (Weston 1996, Olofsdotter,1998b). Allelopathic effects of Eucalyptus was studied by Khan *et al.* (2008).

Autotoxicity:

Autotoxicity is known for example in *Medicago sativa* (alfalfa), *Trifolium* spp. (clovers) and *Asparagus officinalis* (asparagus) (Chung and Miller, 1995, Young, 1986).

Residue effect:

Allelopathic interference of both living plant and of plant residues of the highly aggressive weed *Elytrigia repens*, quackgrass, has been strongly indicated (Weston and Putnam 1985) *Hazardous weeds* In cases where the success of a plant, typically a weed, can not be explained by the competitive ability, allelopathy has been suspected to play a role. Investigations of such observations have established or strongly indicated an allelopathic activity of weeds, e.g.*Avenafatua*(wild oat), *E. repens* (quackgrass), *Cirsium arvense*(Canada thistle) and *Stellaria media* (common chickweed) (Seigler, 1996).

Reforestry and allelopathy:

Allelopathy has been investigated as an explanation of the difficulties of replanting fruit trees in orchards - for example apple (*Malus* spp.), citrus (*Citrus* spp.) and peach (*Prunus persica*) (Rice, 1984, Putnam and Weston, 1986).

Identification and isolationof allelochemicals:

Screening of fractions of plant extracts or leachates for their effects on seed germination of various plant species are frequently used to identify phytotoxic compounds (Macias, 1995, Macias *et al.,* 1998).

Mixture effect:

The release of allelochemicals of different chemical classes from allelopathic plant species has been documented including tannins, cyanogenic glycosides, several flavonoids and phenolic acids such as ferulic, p-coumaric, syringic, vanillic, and p-hydroxybenzoic acids (Kruse *et al.,* 2000)

Release rates of allelochemicals:

Allelopathic compounds released from different plant parts can either be released continuously, within specific periods (e.g. specific developmental stages) and/or in pulses when triggered by external factors as for example precipitation (Zackrisson and Nilsson, 1992, Yoshida *et al.,*1993).

The potential uptake of caffeine by Spearmint (*Mentha piperita* L.), Basil (*Ocimumbasilicum*L.), Sage (*Salvia officinalis* L.), and Oregano (*Origanum vulgare* L.) and the allelopathic effects of these herbs on physiological parameters in coffee (*Coffea arabica* L.) were investigated. (A. Pacheco,2007) Intercropping aromatic plants provides some advantages such as weed control, nutrient recycling, low-external input farming and extra income (Chou, 1986; Fisher, 1986; Rizvi and Rizvi, 1987; Pohlan *et al.,* 2003).

Allelopathy has gained much attention in the field of agro-forestry and weed science. Allelopathy enhances tree survival and reproduction, and thatplants producing allelochemicals can be used in production as cover crops to control weeds. For example, the black walnuts (*Juglans nigra*) accumulate hydrojuglone (in leaves, stems, fruits and roots) which when exposed to air, oxidizes to toxic juglone. Thejuglone can volatilize from the leaves, or leach by rain drops. Catechin is highly phytotoxicagainst *Arabidopsis thaliana* and *Festuca idahoensis (*Bais and Kaushik, 2010) allelopathic potential of Iranian wheat (*Triticum aestivum* L.) cultivars against weeds have been studied by Labbafi *et al.* (2010)

National scenario:

Numerous crops have been investigated more or less thoroughly for allelopathic activity towards weeds or other crops. A suppressive effect on weed, possibly mediated by the release of allelochemicals has been reported for a wide range of temperate and tropic crops. These include Alfalfa (*Medicago sativa*), Barley (*Hordeum vulgare*), Clovers (*Trifolium* spp., *Melilotus* spp.) Oats (*Avena sativa*) Pearl millet (*Pennisetum glaucum*), Rice (*Oryza sativa*) Rye (*Secale cereale*), Sorghums (*Sorghum spp.*), Sunflower (*Helianthus annuus*), Sweet potato (*Ipomoeabatatas*) and Wheat (*Triticum aestivum*) (Narwal, 1996, Narwal *et al.,* 1998,). Due to their origin from natural sources, some authors suggest that the allelopathic compounds will be biodegradable and less polluting than traditional herbicides (Narwal *et al.,* 1998). Knowledge about the challenges related to the demonstration of allelopathy, as an ecological significant mechanism, is important in the assessment of ecological effects of allelopathic plants. This could for example be relevant if crop species with allelopathic traits are spread to other ecosystems or if the allelopathic traits are spread to other plant species.

Till now, 129 weed species allelopathic to crops have been indentified (Narwal, 1994). The weed residues may exert allelopathic effect on crop plants similar to that of crop residues butdetailed studies are lacking. Allelochemicals released from the weed residues may affect the crop plants in following manner: (i) inhibition of biological nitrogen fixation, (ii) inhibition of nutrient uptake and (iii) inhibition of seed germination, growth and yield. The negative (simulatory) effects of leaf extracts and leachates of different weedsparts on germination and seedling vigour and final yield on agricultural crops have been reported . The identification of harmful and beneficial weeds can be done by studying its allelopathic effects on crops. Several workers have shown that allelopathy plays an important part in weed and weed interaction (Kumbhar and Dabgar, 2011; Rejila and Vijayakumar, 2011; Eyini *et al.,* 1989; Kumar and Gautam, 2008; Oudhia *et al.,* 1998 and Oudhia, 1999) and weed/ crop interaction (Akmal *et al.,* 2011). Weeds affect crops by way of direct competition and also through their allelopathic effects. Allelopathic effects have been reported for many species including crop plants annual and perennial weeds. *Hyptis suaveolens* may be used as potent bioherbicide to control the spread of *Parthenium* (Kapoor, 2011)

Significance of the study:

Most of the research projects in allelopathy have been designed in such a way that only the inhibitory results are considered significant. The scientists have been very aware, however, of the significance of the chemical stimulation of growth and development of

plants by other plants volatiles or interactions. An allelopathic crop can potentially be used to control weeds by planting a variety with allelopathic qualities, either as a smother crop, in a rotational sequence, or when left as a residue or mulch, especially in low-till systems, to control subsequent weed growth.

The findings may indicate the measures to be taken by different government authorities to overcome the difficulties causeddue to allelopathic effects of invasive plant species on crops. The current trends are aimed at identifying the allelopathic chemicals and working in isolation with them or with analysing the phytochemicals involved. However from an ecological and productivity point of view it becomes necessary to study the basic effects of presence of weed residues in a field

Some basic approach in alleopathic studies:

Petriplate methods:

Allelopathic effects of *Alternanthera sissalis (l.) Eupatorium odoraturm (l.), on Vigna radiata (l.), Oriza sativa, vigna aconitifolia (l.), Lablab purpureus (l.) and Cicer arientium (l.).* Water extracts of leaf of weeds were prepared at 1%,2%,3%,5% . The seeds of the crops were place in petriplates and germination observed after 7 days. Weight of germinated seed and their corresponding radical and plumule length was recorded .a control was maintained by watering the seed with water. The aqueous extracts significantly effected the various parameters in all the crops studied with a inhibitory effect at higher concentrations (Vaidya and Joshi, 2017).

Table1: Effect of various concentration of aqueous weed extract of Eupatorium on radicle length after 7 days in cms

Conc.	***V. radiata***	***V. aconitifolia***	***O. sativum***	***L. purpureus***	***C. arientium***
Control	7.456	8.949	12.356	10.683	12.63
1	6.325	8.567	11.11	2.296	12.90
2	5.682	7.345	10.256	8.8568	8.601
3	5.459*	6.923	9.435	5.515*	3.871*
5	7.456	5.420*	0*	1.848*	6.429

Table 2: Effect of various concentrations of weed extract of Eupatorium on plumule length after 7 days in cms

Conc.	*V. radiata*	*V. aconitifolia*	*O. sativum*	*L. purpureus*	*C. arientium*
0	9.233	10.678	14.956	15.161	5.62
1	9.118	10.545	13.834	11.663	4.38
2	8.563	9.636	12.983	9.525*	2.62
3	0*	7.692*	10.235	14.600	2.25
5	9.233	4.100*	0*	3.356*	1.357*

Table 3: Effect of various concentrations of weed extract of Eupatorium on fresh weight of seedlings after7 days in gms

Conc.	*V. radiata*	*V. aconitifolia*	*O. sativum*	*L. purpureus*	*C. arientium*
0	0.893	1.311	0.087	2.613	0.679
1	0.694	0.939	0.239	2.490	0.543
2	0.203*	0.803	0.118	2.000	0.468
3	0.842	0.652	0.623	1.546	0.413
5	0.678	0.283*	0.126*	0.331*	0.029*

*Significant at p<.05 values are mean of 60 samples

Table 5: Effect of various concentrations of weed extract of Alternanthera on plumule length after 7 days in cms

Conc.	*V. radiata*	*V. aconitifolia*	*O. sativum*	*L. purpureus*	*C. arientium*
0	7.98	5.23	3.424	8.435	6.32
1	4.20	2.20	6.568	7.128	4.054
2	3.19*	1.53*	6.5817	7.131	3.875
3	6.94	2.80	1.092*	6.169	8.555
5	4.20	6.34	3.425	5.100	2.125*

All the plant extracts showed significantly decreasing trend in the length of radicle, plumule, fresh weight of seedling. The tolerance level of allelopathy activities of various weed extracts . So, in field condition, incorporation of these weeds to the soil affects the growth and yield of succeeding crops. To decrease the allelopathic effect of these weeds on the crop the removal of these plants before it's flowering or before sowing of crops may be

recommended , after further research. All the weed extract showed toxic effects on crops in Alibag.

Table 6: Effect of various concentrations of weed extract of Alternanthera on fresh weight after 7 days in gms

Conc.	*V. radiata*	*V. aconitifolia*	*O. sativum*	*L. purpureus*	*C. arientium*
0	1.2123	1.313	0.596	1.480	0.503
1	0.932	0.946	0.447	1.312	0.412
2	0.912	0.803	0.393	1.201	0.305
3	0.713	0.652	0.867	1.00	0.357
5	0.543	0.298*	0.301	0.333*	0*

*Significant at p<.05 values are mean of 60 sample

In another work it was seen that.effect of various aqueous extracts of weed plants, *Hyptissauveolens (L.), Ricinus communis (L.), Alternanthera sessilis (L.), Ipomoea carnea (Jacq), Malachra capitata (L.) and Cymbopogon citrutus (Stapf),* on seed germination, of *Triticum aestivum L. var k9* were studied. Extracts of1%, 2%, 3% and 5% concentrations of weed extracts were prepared. the seeds of Triticum aestivum L. var k9 were germinated in petridishes. Final germination percentage, weight of germinated seeds and their corresponding radicle and coleoptile length was recorded at the end of 7 days along with total chlorophyll and total proteins. Seedling vigor index was calculated (SVI) using the formula percent germination× by average radical length. A control was maintained by watering the seeds with water. Statistical analysis was done to compare the mean values using T Test. There was a significant reduction in all the parameters at high concentrations of the weed extracts in all the plant species under the study. The tolerance level of allelopathic activities of various weed extractsin terms of seed vigor index represented *as Cymbopogon strictus>Ipomoea carnea>Hyptissaveolens>Malachracapitata> Ricinus communis> Alternanthera sessilis*. All the weed extracts studied had a marked effect on all the parameters studied, suggesting sever allelopathic effects on seed germination of Wheat (Joshi and Joshi, 2016).

Selection of the plants:

Aqueous extracts of leaves of weeds preferably in the growing period be selected, oven dried, crushed and sieved to store.

Plant sampling and preparation of extracts:

Leavesbe washed several time with water and the method proposed by Dhawan and Narwal ,1994 followed to prepare aqueous extract and various concentrations .

Bioassay Studies:

Bioassay studies can carried out on .ten seeds of a crop by placing them om on Whatman No.1 filter paper in Petri plates (9 cm x 2 cm) or on germinating paper.Petriplates moistenedwith 2 ml/ plate of leaf extract, distilled water (control) and incubated in room temperature. l. Germination percentage, root and shoot lengthcan measured after 15 days. Control and weed aqueous extract treated seeds be kept in replicates of 5 for various concentrations and combinations of weed and crop.

The Equal-Compartment-Agar-Method (ECAM):

This method was successfully carried out by Joshi and Joshi (2017). Equal-Compartment-Agar Method (ECAM) was employed on two major crops. The weeds under consideration were *Hyptissauveolens (L.), Ricinus communis (L.), Alternanthera sessilis (L.), Ipomoea carnea (Jacq.), Malachra capitata (L.) and Cymbopogon citrutus (Stapf)* were used for the study and its effect *on Wheat (Triticum aestivum L.) and Moong (Vigna radiate)* are studied. The studies were carried out using agar method in six well Petri dish. The crop seeds were germination in sterilized agar using the powdered leaf extracts of the weeds at 10 and 50 mgs of dry leaf powder. The length of the radicles of both the crops were measured after three days and compared with a control. OverallAllelopathic Potential of the five weeds were derived from the rate of inhibitor of radicle growth. Wheat was most affected by the weeds in the study while moong showed marginal effects. Weed litter at 50mgs affected both the crops severely.This method successfully separates competition from allelopathy (Wu *et al.,* 2000b).

Germination indices as a tool:

Six germination indices i.e. Total germination (also known as final germination percentage)(GT), Number of days required for 50% of the total number of seeds to have germinated (T50), Number of days for 50 % of the total number of seeds germinated (T'50), Speed of germination (S), Speed of accumulated germination (AS) and Coefficient of the rate of germination (CRG) also help in understanding the allelopathic effects of weeds in laboratory . The indices can be calculated as described by Anjum and Bajwa (2005).

Sandwich Method for allelopathic studies:

The Sandwich Method involves the placing of pre-weighed samples of dried plant material into the wells of a six well plate. Each well has an area of 10 cm2,which corresponds to 10 or 50mg powered litter in each well, which is equivalent to litter deposition rates of 10 gm-2 and 50 gm-2. This is the low and high ends of natural litter deposition rates. Each well volume is close to 10 ml so the equivalent concentrations of 10 mg and 50 mg leaf material were therefore 1 mg ml-1 and 5 mg ml-1 that is 1 gl-1 and 5 gl-1 respectively. (Smith, 2003)

Sandwich Method Protocol. Powdered plant materials were carefully weighed then gently tipped into the wells of a six well multiwall plate .The top row of 3 wells were filled with 10 mg of plant sample per well. The bottom three were filled with 50 mg plant sample per well. Three multi dishes were usually filled per sample, giving three replicates per sample, with three repeats. A control dish was set up for each experimental run, using agar only.

Type of agar and its preparation:

Following Fujii'sprotocol (Fuji *et al.,* 2004), low temperature agar was used. The agar 0.75% concentration w/v in water was boiled in a microwave to ensure that the agar melted properly and it was then decanted, cooled and five milliliters of the agar was then carefully pipetted into each of the sample and control wells using a pipette and allowed to set. This took approximately 30 minutes. A further 5 ml of agar was pipetted on top of the first layer. A sterilized needle was used to push the risen plant material below the surface so that a uniformly smooth upper surface was created when the agar set.

Arrangement of seeds and incubation of multiwell plates:

4 surface sterilized seeds of respective crop species were placed horizontally on the surface of the agar in each well using a pair of forceps.100 seeds of the crops were studied. The seeds were arranged in a regularly spaced crisscross pattern. The lids of the plates were then closed and sealed with laboratory tape to prevent desiccation of the agar. The plates were wrapped in Aluminium foil to20°C for three days. The multiwell plates were opened for measurement. The number of germinating seedlings was recorded and then the seedlings with the longest and shortest radicles in each well were discarded in order to maintain the central tendency and normality of the data. The radicle and hypocotyl lengths of each of the remaining three seedlings were then measured. Percentage elongation relative to control was calculated and converted to percentage inhibition, where 0% represents no inhibition and 100% complete inhibition.

In order to rank the data collected from separate experiments in terms of their allelopathic effects by plant organ and also by species, the concept of Overall Allelopathic Potential (OAP) can be applied for this study (Smith, O.P, 2013)

Calculations are made using the formula:

OAP = mean (I10 + I50) / 100

Where I10 = % inhibition of radicle growth compared to the control at 10 mg concentration and I50 = % inhibition of radicle compared to the control at 50 mg concentration. Using the mean of the sum of the radical percentage inhibitions divided by 10, a score between 0.0 and 1.0 was obtained and the data were ranked according to this score. A maximum score of 1.0 would indicate that the test material had totally inhibited growth, while a score of 0.0 would indicate that no allelopathic inhibition had occurred.

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STATUS, THREATS AND CONSERVATION OF BIODIVERSITY IN INDIA

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Abstract:

Indian subcontinent is unique in having great natural beauty in its biomes and also in possessing a rich and diverse wild life flora and fauna. It includes 47,000 species of plants and 81,000 animal species. India is one of the 12 mega diversity countries in the world. India has four biodiversity hot spots and thus possesses a large number of endemic species. Biodiversity provides a variety of environmental services from its species and ecosystems to the human society. Over exploitation of natural resources is the largest cause of biodiversity loss. In India nearly 450 plant species, 150 mammals and 150 bird species are in the categories of threatened or endangered. A number of measures are now being taken the world over to conserve biodiversity including plants and wild life.

Introduction:

Biodiversity refers to the variety and variability among all groups of living organisms and the ecosystem complexes in which they occur.In the convention of Biological Diversity (1992), biodiversity has been defined as the variability among living organisms from all sources including inter alia,terrestrial,marine and other aquatic ecosystems and the ecological complexes of which they are apart.All living organisms are an integral part of biodiversity and provide invaluable services to mankind[6]. In recent times the ever increasing loss of biological wealth has facing serious threat to the human being. The prevailing illiteracy, poverty, lack of scientific development and population explosion are some of the factors responsible for the degeneration of biodiversity[7].

Bio geographical classification of India:

India has different types of climate and topography in different parts of the country and these variations have induced enormous variability in flora and fauna. India has been

divided in to 10 bio geographical zones. Some of the biogeographic zones and their Major flora and fauna are listed in Table 1.

Table 1: India's major biogeographic habitats

Biogeographic Zone	**Biotic province**	**Important flora and fauna**
Trans Himalayan	Upper regions	Pine, Deodar, wild sheep, yak, snow leopard, wolf
Himalayan	North- west, west, central and east Himalayas	Pine,cork tree,sal,Dhaak.Castor Wild bear,sambar,leopard,musk deer
Desert	Kutch ,Thar,Ladak	Acacia,Zizyphus,date palm, wild ass,Desert cat
Semi-arid	Central India	Acacia, date palm,peepal Gir lion,Tiger
Western Ghats	Malabar coast, western ghat mountains	Sheesham,peepal, Tortoise,frog,lizards,snakes
Deccan peninsula	Deccan plateau, south central plateau, Eastern plateau,	Acacia, Tuna, pine, castor, Sambar, sloth bear, Tiger, Elephant,Wild buffalo
Gangetic plain	Upper Gangetic plain, Lower Gangetic plain	Sal,Acacia,Jamun,Mango,Bael, Stag,Rhinoceros,Alligator,Turtle
North-East India	Brahmaputra valley North-Eastern Hills	Bamboo, Sal ,Jack fruit, castor Elephant, Rhinoceros, Deer, Porcupine
Coasts	West coast and east coast	Coconut,Banana, Dolphine,Turtle,Alligator
Islands	Andaman,Nicobar,Lakshadweep Islands	Jack fruit,coconut,Cloves, Dolphine,Alligator,Molluscs

India has provided conditions for high levels of biological diversity.6% of the global species are found in India. It is estimated that India ranks 10th among the plant rich countries of the world, 11th among the endemic species of higher vertebrates, 6th among centres of diversity and origin of agricultural crops.30, 000 to 50,000varieties of rice and a number of cereals, vegetables and fruits.

India is one of the 12 mega diversity countries in the world[8]. TheMinistryof Environment and Forests, Government of India (2000) records 47,000 species of plants and 81,000 species of animals which is about 7 % and 6.5% of global flora and fauna.India shows good number of endemic species; about 62% of Amphibians and 50% of lizards are endemic to India. Western Ghats are the site of maximum endemism. Nearly 5000 species of flowering plants and 166species of cropplants had their origin in India. More than 340 species of corals are found in India.

Hot spots of Biodiversity:

India has four biodiversity hot spots the Himalayas, the IndoBurma region, the Western Ghats and theSundaland. Estern Himalaya is considered to be the cradle of flowering plants. Out of the world'srecorded flora 30% are endemic to India of which35, 000 are in the Himalayas, 163 endangered species. Western Ghats includes 40% of the total endemic plants species.62% amphibian and 50 % lizards are endemic to western ghats.Indo Burma region includes 7,000 species of plants which are endemic in nature. Sundaland: It is host to 10 % of worlds flowering plants.12 % of world's bird and more than 25% of the word's fishes.60% of the 25,000 species of vascular plants are endemic. It hosts 2.000 species of orchids[9]. Total number of species in some major groups of flora and fauna in India are listed in Table.2

Table.2 Distribution of species in some major groups of flora and fauna in India

Plants	**Number**	**Animals**	**Number**
Bacteria	850	Lower groups	9979
Fungi	23,000	Mollusca	5042
Algae	2,500	Arthropoda	57,525
Pteridophytes	1,022	Pisces	2546
Gymnosperms	64	Amphibia	472
Angiosperms	15,000	Reptiles	428
		Birds	1228
		Mammals	372

Threats to Biodiversity:

In recent times the ever increasing Loss of biological wealth has posed serious threat to the very existence of mankind. Scientists have estimated that human activities are likely

to eliminate approximate 10 million species by the middle of this century. Tropical forest cover is being lost at the rate of about 0.16 billion hectare per decade. All over the world about 60.000 species of plants and 200 species of animals are on the verge of extinction.

Endangered species:

In India, nearly 450 plant species have been identified in the list of endangered species. About 150 mammals and 150 species of birds areestimated to be endangered.

A few species of endangered animals and plants are given below.

Reptiles: Gharial, green sea turtle, tortoise, python

Birds: Great Indian Bustard, pelican, peacock, Great Indian Hornbill.

Mammals: Indian wolf, red fox, sloth bear, red panda, tiger, leopard, striped hyena, Indian lion, golden cat, desert cat, dugong.Hoolock gibbon,lion tailed macaque, Nilgirilangur, capped monkey, golden monkey.

Plants: orchids and many medicinal plants.[10]

Causes ofloss of Biodiversity:

Loss of natural habitat or destruction of habitat:

Destruction and loss of natural habitat is the main cause of biodiversity loss. Billions of hectares of forests and grasslands have been cleared over the past 10.000 years for conversion in to agricultural lands.thousands of species which perished due to loss of their natural habitat.The wet lands are destroyed there by causing huge bio diversity loss.

Habitat fragmentation:

Habitat fragmentation is the process of dividing a contiguous area of natural habitat into smaller, more isolated patches (Wilcove, Mclellan and Dobson 1986)[11]. Due to habitat fragmentation many animals are vanishing.

Poaching:

Illegal trade of wild life products by killing prohibited endangered animals .poaching of wild life has led to extinction of various species in the biosphere.

Man –wild life conflicts:

Anthropogenic activities like developmental pressure, encroachment, over exploitation have increased the man wild life conflict and led to loss of wild life.

Introduction of exotic species have posed threat to many native species.

Conservation of biodiversity:

Conservation of biodiversity involves protection, up liftment and scientific management of species at its optimum level in order to derive sustainable benefits for the

present as well as for the future. A number of measures are now being taken the world over to conserve biodiversity including plants and wild life.

There are two approaches of biodiversity conservation

***In situ* conservation (with in habitat):**

This is achieved by protection of wild flora and fauna in nature itself

Eg: Biospheres reserves, Nationalparks, sanctuaries and reserve forests.

***Ex situ* conservation (outside the habitat):**

This is done by establishment of gene banks.Seed bank, Zoos, botanical garden and culture collection.At present in India 7 major Biosphere reserves 80 National parks, 420 wild life sanctuaries and 120 Botanical gardens covering 4% of the geographical area [12].

Biosphere reserves:

Conserve some representative ecosystem as a whole for long term in situ conservation.Some important biosphere reserves in India are listed in Table.3

Table 3: Important Biosphere reserves in India

Name of the Biosphere	**State**
Nanda Devi	Uttar Pradesh
Manas	Assam
Sunderbans	West Bengal
Gulf of Mannar	Tamil Nadu
Nilgiri	Karnataka, Kerala, Tamil nadu
Great Nicobar and Similipal	Orissa

National park:

Table 4: Some important national parks in India

Name of national parks	**State**	**Important wild life**
Kaziranga	Assam	One horned Rhino
Gir National park	Gujarat	Indian Lion
Bandipur	Karnataka	Elephant
Periyar	Kerala	Tiger, Elephant
Corbett	Uttar Pradesh	Tiger
Ranthambore	Rajasthan	Tiger
Sariska	Rajasthan	Tiger
Dachigam	Jammu and Kashmir	Hangul
Kanha	Madhya Pradesh	Tiger

It is an area dedicated for the conservation of wild life along with its environment. Grazing of domestic animals, all private rights and forestry activities are prohibited with in a national park.Some important national parks in India are listed in Table 4.

Wild life Sanctuaries:

It also protected areas wherekilling, hunting, shooting or capturing of wild life is prohibited except under the control of highest authority. Private ownership rights are permissible and forestry operations are also permitted that they do not affect the wild life. Some important wild life sanctuaries in India are listed in Table.5

Table 5: Important Wild life sanctuaries in India

Name of the sanctuaries	**State**	**Major Wild life**
Ghana Bird sanctuary	Rajasthan	300 species of birds
Hazaribagh sanctuary	Bihar	Tiger,Leopard
Sultan pur Bird sanctuary	Haryana	Migratory Birds
Madumalai wildlife sanctuary	Tamil Nadu	Tiger,Leopard**,**Elephant
WildAss sanctuary	Gujarat	Wild ass,wolf,nilgai,chinkara
Periyar wildlife sanctuary	Kerala	Tiger,Leopard,Elephant,slothbear,neelgai,wild boar
Abohar wild life sanctuary	Punjab	Black buck and several species of birds
Jaldapara Wildlife sanctuary	West Bengal	Rhino,Elephant,Tiger, Leopard, wild boar
Nalsarovar Bird Sanctuary	Gujarat	Water birds

Community conservation:

These are the efforts to protect biodiversity in which the local community participates as much as possible. The scientists and people who live in a certain place work together to save biodiversity of that area.

Protection by Law:

preventwild life depletion several Acts have been made from time to time by state as well as central government. The important wild life protection Acts are:

- Madras wild life Act 1873.
- All India Elephant preservation Act 1879
- The Indian Forest Act 1927.
- All India wild life protection Act 1972.
- Forest (conservation) Act 1980.
- The wild and animal protection Act 1992.
- Biological Diversity Act 2002.

***Ex situ* conservation:**

This type of conservation is mainly done for conservation of crop varieties.

Important gene bank or seed bank facilities in India

- National Bureau of plant Genetic Resources (NBPGR): is located in New Delhi. Seeds and pollen of varieties of crops are preserved.
- National Bureau of Animal Genetic Resources (NBAGR): located at karnal, Haryana. It preserves the semen of domesticated bovine animals.
- National facility for plant Tissue culture Repository (NFPTCR):It provide facility of conservation of varieties of crop plants and trees by tissue culture.

Agencies protecting Biological diversity:

A numberof National and international organizations are actively involved in wildlife conservation.

- International Union for Conservation of Nature and natural resources (IUCN).
- Species Survival Commission(SSC)
- Convention on International Trade in endangered species of wild flora and fauna(CITES)
- Convention on Biological Diversity (CBD)
- World Wide Fund for nature(WWF)
- World Conservation Monitoring Centre(WCMC)

Conclusion:

The biodiversity in nature is essential to human existence. India has rich and diverse wild life flora and fauna. Out of the world's recorded flora 30% are endemic to

India.Over exploitation of natural resources is the largest cause of biodiversity loss.A number of measures are now being taken the world over to conserve biodiversity including plants and wild life.Natural habitat of wild animals should be carefully protected. Awareness regarding the importance of biodiversity should be created among the people and research on wild life should be encouraged.

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HEALTH RISKS IN MIGRANT WORKERS DURING PANDEMIC OUTBREAK IN BENGALURU

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Abstract:

Bengaluru is one of the fastest growing metropolitan city and people from different places come here in search of their livelihood doing different types of jobs or work to lead their lives. Some are educated, they work in offices or factories and some are illiterate, who work as masons, maids, and domestic workers, security guards, in hotels, petty businesses and street hawkers. Most of the migrant workers are daily wage workers and below poverty line. Some of them do not have proper shelter, clothing and sometimes cannot even afford two meals a day. During pandemic the migrant workers face health risks like malnourishment, no proper sanitization, cannot maintain physical or social distancing and cannot afford for essentials and medicines as many industries, business outlets, offices, educational institutions, restaurants, malls and other places where these migrant workers work were closed during lockdown and during relaxation period till the citizens accustom to new normal life. The new normal after September 2020 has given some chance for the migrants to work in offices, business outlets, eateries, cleaning workers and as masons to improve the economic conditions and health.

Keywords: Bengaluru, Migrants, Pandemic, Health

Introduction:

Bengaluru is one of the most preferred cities for immigrants for its weather conditions, employment opportunities, cost of living in comparison to other major metro cities. It is a hub for many different types of industries, educational institutions, restaurants, hotels, malls, offices, business outlets, transport and logistics, construction and

infrastructure industries. As the development is speeding there is an increased requirement for work force to do the work and migrant workers from different states, districts, villages, far and near come to Bengaluru in search of livelihood. Migrants work in different sectors like factories, as cleaning staff in offices, restaurants, hotels, malls, business establishments, as waste pickers, as security guards, as masons, as travel personnel, daily wage workers and majority of them live below poverty line and cannot afford for proper nutritious food, living shelters, proper toilets, sanitization, medicines and medical facilities. During pandemic outbreak like COVID-19 many migrants face more health risks. This study was done to find the possible health risks during pandemic outbreak on migrant workers.

Methods:

Based on the observations done on the living conditions of migrants working in Bengaluru, their livelihood, working conditions, shelters they lived, availability of food and medicines, .Many migrants faced economic loss during pandemic outbreak lockdown and relaxation period after lockdown during June 2020 to September 2020, which led to health risks and after September 2020 the living conditions of migrants improved and could offered for shelter and food.

Discussion and Conclusions:

Migrants in Bengaluru are about nearly 50 percent of the total population, Migrants are from Tamil Nadu, Kerala, Andhra Pradesh, West Bengal, Rajasthan, Bihar and many other states of India. Within Karnataka migrants are from Mysore, Tumkur, Mandya, Kalaburagi. Udupi, Shivmoga, Davanagere, Raichur and other districts. Many of these migrants work in public sectors and nearly 5.2 lakhs Tamil Nadu migrants work in Bengaluru and most of the Rajasthan migrants have business outlets[1]. During pandemic people stay at home do not go to bars, restaurants, theatres and these effect migrants who are working in those places and cannot afford for daily essentials and try to return to their places[2]. Many of these migrants lose daily earnings due to lockdown and even highly skilled migrants are laid off when companies are downsizing, so leading to lack of health care, financial security and social protection. All these economic struggles lead to returning of migrant workers to their homes[3]. And many of them trudge hundreds of miles on foot to get to their homes[4] exposing them to pandemic disease, starvation, community spreading for not maintaining social or physical distance and sometimes not wearing masks and no proper sanitization was more severe during lock down from the month of April to July 2020. Migrants have risks of health due to poverty as they cannot afford nutritious food to feed

themselves and their families, some of them do not have proper shelter and sometimes living in congested shelter with small space with many people leading to spreading of pandemic faster when an infectious person comes in contact with the healthy person. They cannot afford for sanitization which leads to spreading of disease, using common toilets for both diseased and healthy people is also one of the reasons, sometimes they do not get potable water for drinking, bathing and washing purposes and many donot take bath for many days and wear untidy clothes for many days and when they come in contact with symptomatic virus diseased person may have risks of getting the disease spread to healthy person..

Community spreading is more common among these people as they cannot afford for more space leading to no social distancing, some of them do not wear face mask, and if they are already suffering from illness like Influenza Like Illness (ILI) and Severe Acute Respiratory Infections (SARI) can turn positive for COVID-19[5, 6] and those who are suffering with Diabetes and hypertension cannot afford for medical treatment and may die when they are exposed to COVID 19 and sometimes it may lead to herd immunity. Many initiatives are taken to support such vulnerable groups during COVID 19 by providing sanitary kits, ration kits from Non- Governmental Organizations[5, 7] and even Karnataka Government has provided many facilities for the welfare of the migrants. The migrants should be cared, provide them work, proper shelter, meals, medicines and sanitization. The situation after lockdown relaxation after September 2020 has given chance for some migrants to work in some of the places like hotels, offices, busines outlets, cleaning workers and as masons. These have improved their economic situations and can offered for food, shelter and certain medicines.

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DETERMINATION OF VARIOUS PHYSICO-CHEMICAL PARAMETERS AND WATER QUALITY INDEX (WQI) OF THE SABARMATI RIVER, AHMEDABAD, GUJARAT, INDIA

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Abstract:

Water is the lifeblood of the Earth, and coverage to water through river systems sustains the furthermost of possible life. Various factors such as quality, quantity, and timing of flow are responsible for the health of the river. The spectrum of river flow unpredictability is an ecologically crucial constituent in a river ecosystem.Theecological constancy and quality of rivers in delicate regions urgently need to be evaluated before reasonable protection and restoration.This investigation was aimed to determinethe current status of Physico-chemical characteristics of Sabarmati River, Ahmedabad, India. Monthly changes in physicochemical parameters such as water temperature, pH, turbidity, total dissolved solids, total hardness, chlorides, phosphate, nitrates, dissolved oxygen, and biological oxygen demand were analyzed for a period of one year from September 2013 to August 2014. The results indicated that the Physico-chemical parameters of the water were within the permissible limits and can be used for domestic and irrigation. The correlation coefficient indicates exhibited positive and negative relationship.

Keywords: Riverine ecology; Environmental flow; Water Quality Index; Physico-Chemical Parameters; Freshwater bodies

Introduction:

Water is an importantconstituent of the environment and it sustains life on the earth. All animals and organisms depend on water for their existence [1]. Freshwater bodies are significant wetlands located in and around human habitations as they are commonly semi-natural ecosystems created by the man in landscape suitable for water stagnation [2]. Quality drinking water is important for life. Contaminants such as bacteria, viruses, heavy metals, nitrates, and salt have polluted water supplies as a result of inadequate treatment and disposal of waste from humans and livestock, industrial discharges, domestic discharge, and over-use of limited water resources [3]. There areseveral reported cases of typhoid, diarrhoea, and other water-borne diseases arising from the consumption of contaminated water. Different works have been reported by many researchers on water quality assessment. Today contaminated water kills more people than cancer, AIDS, wars, terrorism, or accidents [4]. Physico-chemical properties were influenced by season to season and also anthropogenic activities like agriculture, urbanization, domestic sewage, etc. in the catchment area resulted in deterioration of water quality [5]. Temperature, turbidity, nutrients, hardness, alkalinity, dissolved oxygen, etc. are some of the important factors that play a vital role in the growth of living organisms in the water body. Water quality indicates the relation of all hydrological properties including physical, chemical, and biological properties of the water body. Hence water quality assessment involves the analysis of physic-chemical, biological, and microbiological parameters that reflects the biotic and abiotic status of the ecosystem [6]. The water quality index provides a single number that expresses overall water quality at a certain location and time, based on several water quality parameters. The objective of the water quality index is to turn complex water quality data into information that is useful for the public. Water Quality Index, indicating the water quality in terms of an index number, offers a useful presentation of the overall quality of water for the public or any intended use as well as in the pollution abatement programs and water quality management [7].

In view of the above, the present study deals with the assessment of Physico-chemical characteristics of water.

The Sabarmati River is one of the biggest rivers of Gujarat. The legend is that Sultan Ahmed Shah of Gujarat, resting on the bank of Sabarmati, was inspired by the courage of a rabbit chasing a dog to the extent of establishing Ahmedabad in 1411. The river is originates in Dhebar Lake in Aravalli Range of the Udaipur, Rajasthan, and meets the Gulf of Khambat of Arabian Sea after traveling 371 km in a south-westerly direction. The Sabarmati basin has a maximum length of 300 km. and a maximum width of 105 km.

The total catchment area of the basin is 21674 km^2 out of which, 4124 km^2 lies in Rajasthan State and the remaining 18550 km^2 in Gujarat State.

Latitude: 22^0 18' 00" N

Longitude: 72^0 22'00" E

Maintain by: Ahmedabad Municipal Corporation

Figure 1: Four different sites of showing sampling points of Sabarmati River, Gujarat, India

The Sabarmati River is one of the four major rivers that traverse the alluvial plains of Gujarat. It rises in the Aravalli hills at a North latitude of 24^{o}40' and East longitude of 73^{o}20' in Rajasthan State. The river is known to be under contamination menace by wastes derived from industrial sources, sewage, and agricultural activities that alter the physicochemical and biological properties. The River was much contaminated by the addition of plastics and other waste by the visitors and local peoples of Ahmedabad. Ganesh Chaturthi is the major festival that added Plaster of Paris in the rivers which alter the ecology of the biotic environment. The development of the Sabarmati Riverfront increased the elegance of the river and was visited by many local and other peoples.

Material and Methods:

Collection of samples:

The water samples were collected in polyethylene bottles. Initially, the prewashed bottles were rinsed with sample water. The closed bottle was dipped in the lake at the depth of 0.5 m, and then a bottle was opened inside and was closed again to bring it out at the surface. The samples collected in three replicates from ten different points were mixed to prepare an integrated sample (Figure 1). The study area experiences a seasonal climate and is broadly divided into three seasons as monsoon (June to September), winter (October to January), and summer (March to May).

Physico-chemical parameters:

To study the Physico-chemical properties of the lake water content, water samples were collected from the lake surface in a clean polythene container for the period of one year, September 2013 to August 2014. Samples were collected during morning hours in between8.00 to 10.00 a.m. using the one-liter container. The physical and chemical parameters were analyzed in the seasons of monsoon, winter, and summer, respectively. Parameters including electrical conductivity, total dissolved solids, pH, alkalinity, total hardness, calcium, magnesium, dissolved oxygen, chloride, nitrate, and biochemical oxygen demand were analyzed. Parameters such as pH, electrical conductivity, and dissolved oxygen were directly evaluated in the study area, whereas other parameters were analyzed in laboratories. The parameters were compared according to the standard methods described in the literature (8-10).

Table 1: Water Quality Index (WQI) and it's status according to (15-16).

Water Quality Index Level	Water Quality Status
0-25	**Excellent water quality**
26-50	**Good water quality**
51-75	**Poor water quality**
76-100	**Very poor water quality**
>100	**Unsuitable for drinking**

The weighted arithmetic index method (17-18) was used for the calculation of the water quality index (WQI) of the water body. Further, quality rating or sub-index (qn) was calculated by the following expression.

$$q_n = 100[V_n - V_{10}] / [S_n - V_{10}]$$

Where: q_n= Quality rating for the *nth* water quality parameter,

$\mathbf{V_n}$= Estimated value of the *nth* water quality parameters of collected sample,

$\mathbf{S_n}$= Standard permissible value of the *nth* water quality parameter,

$\mathbf{V_{10}}$= Ideal value of the *nth* water quality parameter in pure water.

(i.e. 0 for all other parameters except the parameter pH and Dissolved Oxygen (7 and 14.6 mg/L respectively.) (Let there be *n* water quality parameters and quality rating or sub-index (*qn*) corresponding to *nth* parameter is a number reflecting the relative of this parameter in polluted water concerning its standard permissible value.)

Unit weight was calculated by a value inversely proportional to the recommended standard value Sn of the corresponding parameter.

$$\mathbf{W_n = K / S_n}$$

Where: $\mathbf{W_n}$ = Unit weight for nth water quality parameter,

$\mathbf{S_n}$ = Standard permissible value of the nth water quality parameter, K = Constant for proportionality.

The overall WQI was calculated by aggregating the quality rating with the unit weight linearly.

$$\mathbf{WQI = \sum q_n W_n / \sum W_n}$$

Where: $\mathbf{q_n}$= Quality rating for the *nth* water quality parameter, Wn Unit weight for nth water quality parameter

Quantitative analysis of phytoplankton:

Detailed analyses of the phytoplankton population are done by estimating the number in each species. The phytoplankton consisting of individual cells, filaments, and colonies are counted as individual cells. When colonies of species are counted, an average number of cells per colony is counted, and in filamentous algae, the average length of the filament has to be determined. For this analysis Sedgwick Rafter Counting cell was used, it has approximately 50 mm long, 20 mm wide, and 1mm deep. The total volume of the cell is 1 ml.

Phytoplankton identification:

From the concentrated sample, the slides for the plankton were prepared. Then these slides were placed under a microscope and the phytoplankton was observed in 100 X in the binocular microscope. The images of the Phytoplankton are captured by using a digital camera. Later on, the Phytoplankton is identified by using the books 'The Fresh Water Alage', Fresh Water Diatoms of Maharashtra, Marine & Freshwater Plankton and 'Identification of the most common Freshwater Algae [11-13].

Result and discussion:

The Physico-Chemical Analysis of Water at Sabarmati River:

The Physico-chemical parameters such as Temperature, pH, Electric Conductivity, Turbidity, Alkalinity, Dissolved Oxygen, Total Dissolve Solid, Calcium, Magnesium, Sodium, Chloride, Phosphate, Biological Oxygen Demand, Nitrate, and Total Hardness of water were analyzed for the Sabarmati River. These parameters were taken season at the 3 different places of the River which were Indira Bridge, Nehru Bridge, and Chandranagar Bridge. The mean value of the data with the standard error was calculated which were shown in Table 2. The values of all the parameters were compared by the stranded values of the drinking water set by the WHO 2011. All the parameters were discussed below.

Table 2: Average with standard error values of the physicochemical parameter at Sabarmati River (2013-14)

Average with standard error values of the physicochemical parameter at Sabarmati River				
Sr. No.	**Parameters**	**The year 2013-14**		
		Monsoon	**Winter**	**Summer**
1	Temperature ^{0}C	26 ± 1.27	19 ± 1.22	38 ± 0.42
2	Electrical conductivity (mhos/cm)	3.36 ± 0.47	3.43 ± 0.35	3.54 ± 0.84
3	Turbidity (NTU)	46 ± 0.36	48 ± 0.25	39 ± 0.27
4	Total Dissolve Solid (ppm)	1247 ± 63.77	1133 ± 74.63	1006 ± 36.69
5	pH	7.8 ± 0.63	7.2 ± 0.44	7.3 ± 0.04
6	Alkalinity (ppm)	168 ± 4.87	137 ± 4.79	135 ± 3.31
7	Total Hardness (ppm)	247 ± 9.1	227 ± 4.63	214 ± 8.16
8	Calcium (ppm)	89 ± 0.3	114 ± 1.35	106 ± 4.8
9	Magnesium (ppm)	24 ± 0.54	17 ± 0.56	10 ± 0.71
10	Dissolved Oxygen (ppm)	4.71 ± 0.47	5.41± 0.88	3.40 ± 1.6
11	Chloride (ppm)	44 ± 0.71	36± 0.62	33 ± 0.62
12	Sodium (ppm)	33 ± 0.69	24 ± 0.65	22 ± 0.36
13	Nitrate (ppm)	10.7 ± 0.36	8.8 ± 0.74	7.9 ± 0.36
14	Phosphate (ppm)	2.41± 0.73	1.17 ± 0.33	0.89 ± 0.02
15	Biochemical Oxygen Demand (ppm)	2.13 ± 0.47	1.41 ±0.76	1.11 ± 0.13

Temperature:

Temperature is an important biologically significant factor, which plays an important role in the metabolic activities of the organism. The value of temperature in the study area ranged from 19 ^{0}C to 38 ^{0}C. The maximum temperature was noted during the summer season which made less water in the river and most planktons were grown during this season. The minimum Temperature was 19 ^{0}C during the winter season due to cold low ambient temperature and shorter photoperiod. The temperature showed a gradual increase from March till the onset of the monsoon season in July and gradually decreased from the rainy season to the post-monsoon months. This type of observation was made in freshwater hill streams at Nandadevi and in Sruinsar Lake of Jammu [14].

Electrical conductivity:

Electrical conductivity (EC) is a measure of water capacity to convey electric current. It signifies the amount of total dissolved salts. The conductivity of water depends upon the concentration of ions and its nutrient status and variation in dissolved solid content. Dilution of water during the rain causes a decrease in electrical conductance. Seasonal variation in the conductivity is mostly due to the increasing concentration of salt because of evaporation. Electrical conductivity is an indicator of water quality and soil salinity, hence the relatively high values showed high salinity; thus the waters might not be very suitable for domestic and agricultural use. The values of EC in the Sabarmati River lie in between 3.36 to 3.54 mhos/cm. The maximum EC was reported during summer at 5.14 mohs/cm and the minimum in winter 4.0 mohs/cm (Table 2). These values were within the limits of WHO 500 mohs/cm.

Turbidity:

The turbidity value of the study area ranged between 39 to 48 NTU (Table 2). Turbidity in drinking-water may be due to the presence of inorganic particulate matter in some groundwater or sloughing of biofilm within the distribution system. High turbidity shows the presence of a large number of suspended solids.High turbidity value reported in winter 48 NTU which affects the life indirectly, as its cut of light to be utilized by the plants for photosynthesis thereby lowering the rate of primary productivity. The lowest values of Turbidity were reported in summer 39 due to the growth of aquatic vegetation and also by lowering the volume of water. The value is within WHO standards for drinking water. Higher turbidity affects life indirectly [15-16] as its cut of light to be utilized by the plants for photosynthesis thereby lowering the rate of primary productivity and check the phytoplankton growth.

Total dissolved solids (TDS):

The determination of dissolved solids does not give a clear picture of the kind of pollution concentration of dissolved solids is an important parameter in drinking water and other water quality standards. The matter that remains as residue upon evaporation and drying at 103 to 105oC is solid [17] they give a particular taste to the water at a higher concentration and also reduces its palatability. TDS were below the permissible limits of (500-1500 mg/dm3) set by SON and WHO. TDS of the Sabarmati River lies in between 1006 to 1247. The maximum TDS in monsoon1247 ppm which saw enriches the nutrient status of water and resulted in eutrophication of the aquatic ecosystem. The minimum TDS was during summer at 740 ppm whichimparts a flat, insipid taste to drinking water(Table 2).

pH:

pH is the scale of intensity of acidity and alkalinity of water. It measures the concentration of hydrogen ions. Prapurna and Shashikanth (2002) also found the pH in alkaline trend throughout the study period [18]. Most of the biological processes and biochemical reactions are pH-dependent. The alkaline state of pH might be due to the chemical buffering and release of bicarbonate and carbonate ions or salts [19]. The PH values of samples range are7.2 -7.8 which showed acidic water the whole year (Table 2). The maximum pH reported during Monsoon 7.8and minimum during Winter 7.2 due to accumulated organic matters and decomposition of vegetation which on biological oxidation gives up CO_2 which ultimately reduces the pH.Periodic changes of pH especially season-wise also depend on the climatic regime.

Alkalinity:

Alkalinity is a measure of buffering capacity of the water and is important for aquatic life in the freshwater system because it equilibrates the pH ranges that occur naturally as a result of the photosynthetic activity of aquatic plants. The main source of alkalinity in the water of some lake and river are the addition of soap and detergent used by the residents for bathing and washing purpose. The alkalinity value ranged between 135 -168 ppm (Table 2) which under the WHO limit of drinking water. The maximum value of alkalinity was reported in monsoon season 168 ppm and minimum in summer due to high temperature and less water in the river.

Total Hardness:

In water, the principal hardness-causing ions are calcium and magnesium. Although hardness is caused by cations it may also be discussed in terms of carbonate (Temporary) and non-carbonate (Permanent) hardness. Carbonate hardness refers to the amount of carbonate and bicarbonates in the solution that can be removed or precipitated by boiling. This type of hardness is responsible for the deposition of scale in hot water pipes and kettles. Noncarbonate hardness is caused by the association of the hardness causing cation

with sulfate chloride or nitrate and is referred to as "permanent hardness" because it cannot be removed by boiling. The total hardness recorded in the water ranges between 214 to 247 ppm (Table 2) fell below W.H.O and S.O.N standard of drinking water. The maximum amount of total hardness in the water was recorded during monsoon season 247 ppm due to the addition of large quantities of sewage and detergent along with rainwater and the minimum amount of total hardness was recorded during the summer season. The lowest value of hardness during summer may be due to the evaporation of water.

Calcium:

Calcium is the most abundant ion in fresh water and is important in shell construction, bone-building, and plant precipitation of lime. The analysis of calcium revealed a range of between 89 to 114 ppm and the W.H.O standard of drinking water indicates that the taste threshold for the calcium ion is in the range of 100-300 ppm (Table 2). The maximum amount of calcium recorded in water was during the summer season, whereas the minimum amount of calcium in water was recorded during the monsoon season due to the addition of rainwater in the river. The number of calcium increases during the summer season due to the rapid oxidation /decomposition of organic matter.

Magnesium:

Magnesium tolerance by the human body is lowered than calcium, the high concentrations work as a laxative, and given an unpleasant taste to water; it adds to hardness. Magnesium is found in various salt and minerals, frequently in association with the iron compound. Magnesium is essential for chlorophyll growth and it also acts as a limiting factor for the growth of phytoplankton. The amount of magnesium recorded in the water ranges between 10 to 24 ppm whichwas below the standard limit of WHO i.e. 150 ppm (Table 2). The maximum amount of magnesium in the water was recorded during monsoon season 24 ppm whereas the minimum value was recorded during summer season 10 ppm due to the use of magnesium by the planktons for the photosynthesis.

Dissolve oxygen:

Measurement of dissolved oxygen is a primary parameter in all pollution studies. Dissolve oxygen value is higher in those lakes where there was good aquatic life. Dissolve oxygen value is higher in those lakes where there was good aquatic life. The amount of dissolved oxygen recorded in the water ranges between 3.40 to 5.41 ppm (Table 2). The minimum amount of dissolved oxygen recorded during the monsoon season 3.40 ppm, whereas the maximum amount of dissolved recorded during the winter season 5.41 ppm. The standard value of DO in drinking water is 7.5 ppm which was under the limit in the Sabarmati River.

Chloride:

Chloride in drinking-water originates from natural sources, sewage and industrial effluents, urban runoff containing de-icing salt, and saline intrusion. No health-based guideline value is proposed for chloride in drinking-water by WHO and SON standard of drinking water. However, a chloride concentration lies between 33 to 44 ppm (Table 2). The minimum amount of chloride was reported in Summerdue to the high rate of evaporation and the maximum amount of chloride recorded during the monsoon season which was under the limit of WHO (200 ppm).

Sodium:

Sodium is a natural constituent of raw water, but its concentration is increased by pollution sources such as rock salt, precipitation runoff, soapy solution, and detergent. Sodium is considered harmful in drinking water at high concentrations. The addition of wastewater containing soap solution and detergent from the surrounding slummy area is also responsible for the increase in sodium level in the water bodies. Water containing more than 200 mg/lit sodium should not be used for drinking by those on a moderately restricted sodium diet. A maximum drinking water standard of 100 mg/lit has been proposed for the general public. The amount of sodium recorded in the water of the Sabarmati River ranges between 22 to 33 ppm (Table 2). The minimum amount of sodium was recorded during the summer season and the maximum amount was recorded during the monsoon season. These values were under the limit of slandered values of Sodium in water set by WHO (200 ppm).

Nitrate:

Surface water contains nitrate due to the leaching of nitrate with the percolating water. Surface water can also be contaminated by sewage and other wastes rich in nitrates. Nitrates are contributed to freshwater through the discharge of sewage and industrial wastes and runoff from agricultural fields. The highest amount of nitrate concentration was known to support the formation of blooms. The amount of nitrate recorded in the water of the Sabarmati River ranges between 7.9 to 10.7 ppm (Table 2). The maximum amount of nitrate was recorded during monsoon season 10.7 ppm which suggested that has high nitrate values in monsoon months because of difference in the distribution of nitrate may be due to decomposition processes as well as an aerobic nitrate-ammonification of nitrate to ammonia. The minimum amount of nitrate in water was recorded during the summer seasonat 7.9 ppm. These observations were below the WHO standard limit of Nitrate in Water i.e. 10 ppm.

Phosphate:

Algae require only a small amount of phosphate. An excess amount of phosphate may cause eutrophication leading to extensive algal growth called algal blooms. Phosphate is a generic term for the oxy-anions of phosphorous. Enrichment of water with organic

phosphates and nitrates results in excessive growth of plants and other micro-organisms leading to eutrophication and increased biochemical oxygen demand. The high amount of Phosphate supports the growth of plankton. The amount of Phosphate depends upon the laundry worker and continuous entry of domestic sewage in some areas is responsible for the increase in the amount of phosphate. Organic phosphates are part of living and dead plants and animals; over 85% of total phosphorous is usually found in organic form. The amount of phosphate recorded in the water of the Sabarmati River ranges between 0.89 to 2.41 ppm which was under the limit of WHO 2011(Table 2). The minimum amount of phosphate was recorded during the summer season and the maximum amount was recorded during monsoon season 2.41.

Biochemical Oxygen Demand (BOD):

The Biochemical oxygen demand (BOD) test is the most widely used parameter of water analysis. BOD of surface water decreased progressively and was the lowest at the outlet suggesting that mineralization of organic matter was very great in the lake and phytoplankton photosynthesis contributed the necessary oxygen for this purpose. A large amount of organic matter in water results in the good growth of decomposer organisms on them. These demand a high amount of oxygen for their respiration. This demand leads to DO deficiency and anaerobic conditions. The minimum demand for oxygen in the water was recorded during summer season 1.11 ppm, whereas the maximum demand was recorded during monsoon season 2.13 ppm (Table 2). The standard value of biochemical Oxygen Demand set by WHO is 6-9 ppm which was under the limit.

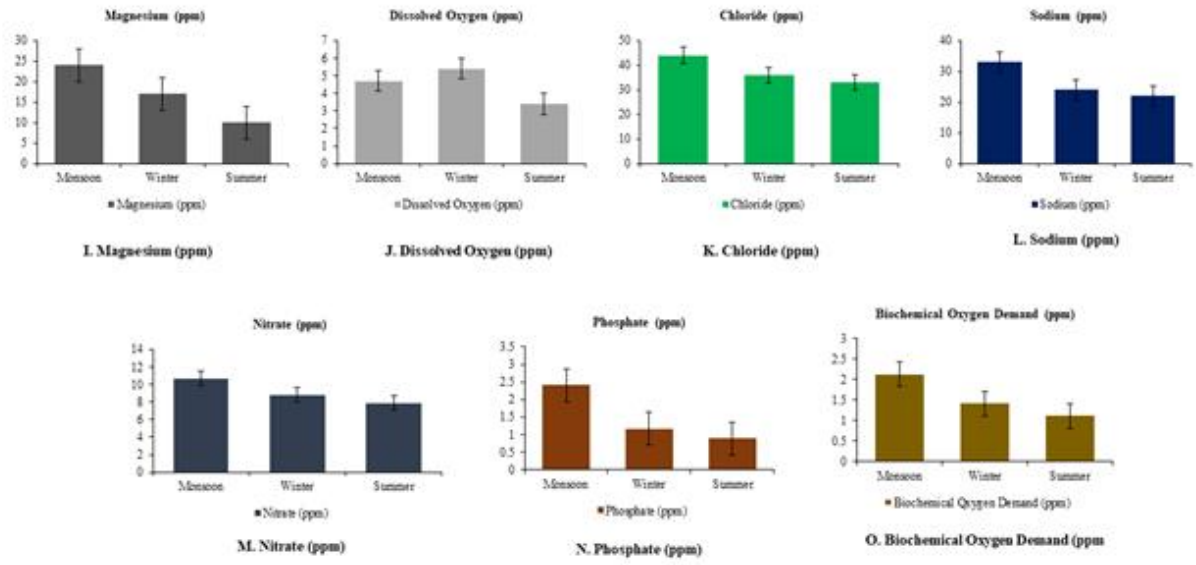

Figure 2: Graphs of seasonal Physico-chemical parameter (A-H) at Sabarmati River (2013-14)

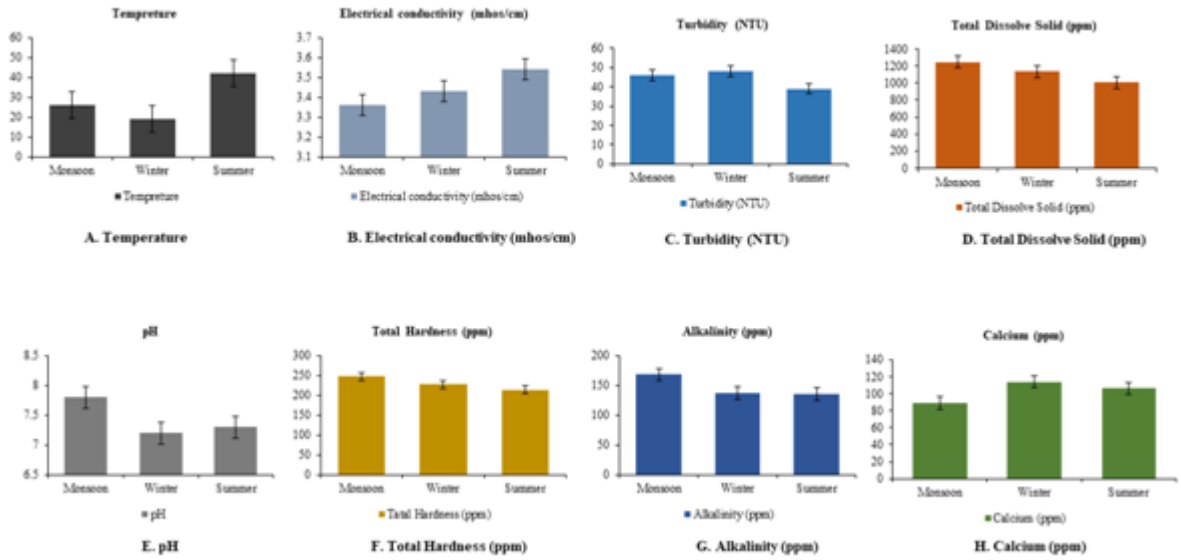

Figure 3: Graphs of seasonal Physico-chemical parameter (I-O) at Sabarmati River (2013-14)

Quantitative Analysis of Phytoplankton in Sabarmati River

'Plankton' refers to those microscopic aquatic forms swimming with little or no resistance to currents and living free-floating suspended in open or pelagic waters. Planktonic plants are called phytoplankton and planktonic animals are called the zooplankton. Plankton, particularly phytoplankton, has long been used as an indicator of water quality. Because of their short life spans, planktons respond quickly to environmental changes. They flourish both in highly eutrophic waters while a few others are very sensitive to organic and/or chemical wastes. Quantitative analysis of phytoplankton was done monthly in 3 different sites of the river an average of the quantitative was calculated. The Quantitative analysis of phytoplankton populations is summarized in Table 3. In the present study, the growth of algae was during the summer season which favorable condition for the growth of algae in terms of nutrients and minerals. The abundance of phytoplankton was lowered during the pre-monsoon because of less water in the river.

In the present study,30 genera and 38 species were reported which belong to the class Chlorophyceae, Cyanophyceae, Bacillariophyceae, and Euglenophyceae. The highest number of species found in the class Chlorophyceae 13 genera and 15 species followed by Bacillariophyceae 9 genera and 12 species, Cyanophyceae 6 genera, and 9 species and Euglinophyceae 2 genera and 2 species were reported (Table 3). In class Bacillariophyceae was dominant in the summer season as well as Cynophyceae was predominant, while

during post-monsoon Chlorophyceae was dominant in the Sabarmati River. In Cyanophyceae *Oscillatoria sp* and *Arthrospira sp* were the dominant species found in the river during whorl year.

In the present investigation, the dominance of Bacillariophyceae like *Navicula, Nitzschia, Gomphonema, Synedra, and Fragilaria* was observed during the summer season. Green algal flora like *Anabaena*, *Spirogyra*, *Merismopedia,* and *Microcystis* was observed, which are indicators of comparatively less polluted water. The algal flora of polluted water bodies the dominance of blue-green alga and diatoms like *Oscillatoria*, *Anabena*, *Microcystis*, *Navicula*, *Nitzschia*, *Synedra*, *Gomphonema,* etc throughout the year. Many green algae such as *Pandorina*, *Endorina*, *Scenedesmus*, *Ankistrodesmus*, *Chlamydomonas*, *Pediastrum*, *Coelastrum*, also occurred abundantly and frequently. The most pollution-tolerant species *Euglena*, *Oscillatoria*, *Navicula*, *Nitzschia*, *Ankistrodesmus*, *Scenedesmus*, *Chlamydomonas*, were recorded to be maximal summer, indicating the highest degree of organic pollution.The algal unit of Cyanophyceae class recorded for Sabarmati River ranges from 23 to 68 ml/L the maximum numbers of Cyanophyceae found during summer and minimum in winter. Class Chlorophyceae ranges between 37 to 51 ml/L, the maximum number of Chlorophyceae found during the summer season and minimum in Monsoon.Bacillariophyceae ranges from 38 to 74 and Euglinophyceae 22 to 27. In class Bacillariophyceae *Nitzschia amphibian*and *Synedra ulna* were dominant species found throughout the year. Euglinophyceae only 2 species *Euglena acus*and *Phacus longicauda* found throughout the year (Figure 5).

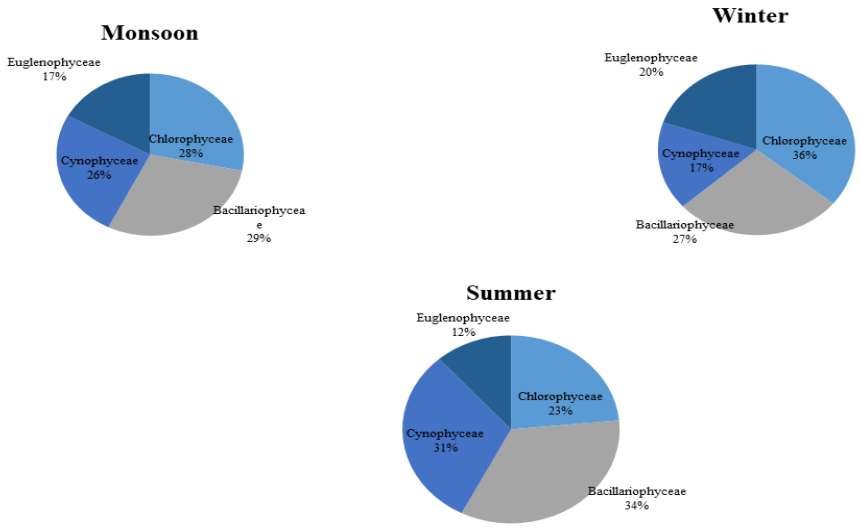

Figure 4: Graphs showing percentage of Phytoplankton class in different season

Table 3: Summary of Phytoplankton class count/ ml

Total No. of phytoplankton in 1 ml concentrated sample of Sabarmati River (2013-14)												
Class	**Sep**	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**
Chlorophyceae	55	61	53	46	41	38	61	56	51	40	22	30
Bacillariophyceae	42	30	37	45	43	48	97	89	65	11	24	21
Cynophyceaec	47	30	13	12	42	85	81	98	52	30	42	27
Euglenophyceae	30	30	37	35	17	27	19	37	18	23	30	22

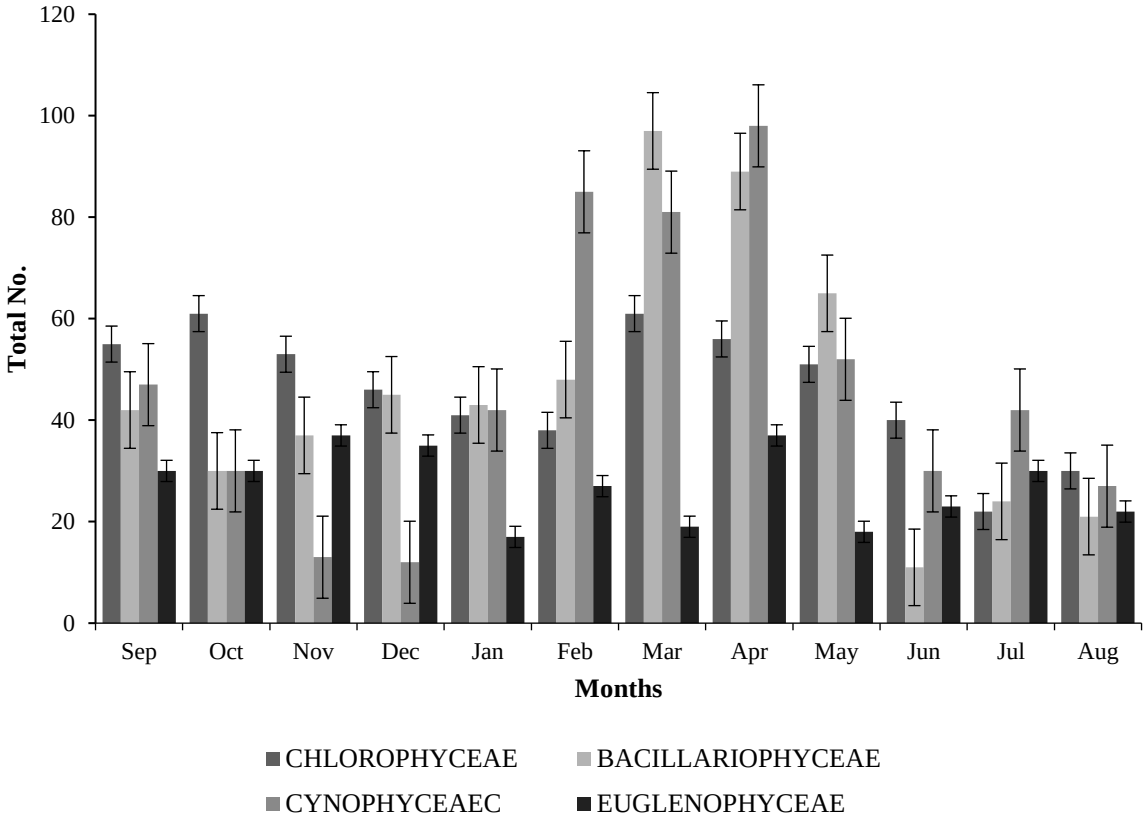

Figure 5: Graph showing monthly variations of a different class of Phytoplankton

Conclusion:

The present investigation analyses the detailed Physico-chemical characteristics and quality of water in Sabarmati River, Ahmedabad, Gujarat, India. The monsoon, winter, and summer seasons show different seasonal fluctuations in various physicochemical

parameters. The water parameters indicate that the water of the lake is a rich high level of organic pollutants. Total dissolved solids, pH, alkalinity, total hardness, and calcium was beyond the permissible limit according to WHO and BIS standards for drinking purpose in the year. The correlation coefficient indicates a positive and negative significant correlation of Physico-chemical parameters with each other. To improve the quality of water there should be continuous monitoring of pollution levels and freeze the direct release of pollutants from the industries and domestic sewage. The authority of AMC and other civic bodies must take action against this.

This present situation may drastically affect the aquatic and terrestrial organism growth in the water repository and significant pollutants emerge from industries and domestic sections pose an additional threat to the water quality in the near future. To sustain the ecology and aquatic life in the Sabarmati River, certain measures and planning must be taken by the civic body to combat the pollution rate in the lake.

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IMPACT OF CLIMATE CHANGE

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Abstract:

Climate change causes extreme heat waves, cold spells, storms, floods and droughts and affects human and animal health, causes deleterious effects to plants and environment. Change in climate develops over a long period or decades. Climate change causes snow melting and strong storms worldwide, forest fires, affect agriculture, increases vectors, pests population and vector borne diseases, water borne diseases, air borne diseases and death of human and livestock, upsets hydrological cycles and famines.

Keywords: Climate change, Human, Environment

Introduction:

Climate is the long-term average of the weather in a given place includes type, frequency, duration, intensity of weather and seasonal variations. Weather is the change in the atmospheric conditions, temperature, precipitation, heat waves of a given place. While the weather can change in minutes or hours, climate change is something that develops over longer periods of decades to centuries[1]. International Panel on Climate Change has reported that drought flood melting of glaciers occurs and will affect human health and death., Greenhouse effect caused by green gases leads to Global warming[2]. Increased temperature on the earth surface led to Global warming[3].

Climate change and human health:

Human health is affected to due increased temperature throughout the globe which causes heat stress and loss of nutrition leading to various types of diseases, allergy, vector borne disease and communicable disease. Winters will be more severe increasing acute bronchitis, asthmatic attack, pneumonia due to colder temperature, bronchial responsiveness increases, increased viral replicator transmissibility, viral induced asthma, Summers will be extreme leading to asthma attacks due to pollen release, increased ozone

near earth surface, Hay fever due to pollen release are also seen during summer, In autumn acute bronchitis, asthma due to viral infection will be increased.. Air pollution causes allergic diseases, chronic disease leading to human mortality. Climate change causes different waterborne disease, increase of vector causing diseases and drought will lead to dehydration and ultimately kill people.

Climate change causes Flood and drought:

Human activities leads to many climatic changes, In India nearly 70 percent population uses stoves and burn firewood and dung leading to increase in Greenhouse gases[4]. Climate change affects sea level, drought frequency, severe precipitation, warming, global land and ocean temperature anomalies, surface temperature change[5] and it is know that India seventh most affected by climate change in 2019 globally . It was reported in 2019 monsoon continued for a month longer than normal in India , flooding caused by heavy rain was responsible for 1800 deaths across 14 states and displacement of 1.8 millions[6]. Flood in Uttarakhand Chamoli, Garhwal in 2021 was due to increase in the temperature which led to the glacier melting and burst out has led to the flooding of nearby places and villages[7]. In Indonesia flood occurred in Java Island Jakarta rivers overflowing resulting in causalities and damages to property, livelihood.

Climate change and snow storm:

Heavy snow storms occurred in Southern states of United States of America causing causalities and people had unavailability of drinking water and had ill effects health on the human, For example in Texas Feb 2021 after 40 years the heavy snow storm occurred people were more affected as they were not prepared for such bad situation and finding scarcity of water and dying of cold temperature. Climate change causes polar vertices also.

Climate change and forest fires:

In Australia forest fires damaged lot of property leading to emissions of gases and smoke in the atmosphere and this occurred due to climate change, Bush fires in Australia 2019 and 2020 , was caused because record breaking temperatures, severe drought, New South Wales, Victoria destroying 2000 homes and forcing thousands of people displacements[8].

Climate change and its effect on agriculture:

Agriculture field residue or stubble burnout was one of the major causes for air pollution is one of the cause of climate change in India, So the Delhi government has taken certain major to stop burnout and converting agriculture waste into manure. Due to climate change causes drought in some places throughout the world leading to scarcity of water leading to heat stress in crops, high temperatures reduces crop yield and increase in the pest population, Favors weed growth, pest proliferation, reduce rainy days reduce production of crops; like wheat, rice maize[9] and migration of pest example locust Schistocerca gregaria migration from Africa, Iran to parts of India, Pakistan occurred in 2019 which damage agricultural crops.

Climate change and its effects on fisheries:

Climate change causes sea level rise, and high temperature causes heating of surface water and it causes heat stress, reproductive effects on aquatic animals and fishes. The change in the availability of nutrition will occur for the fishes. The edible fishes also lose their nutrition and affect food production. The ocean ecosystem changes causing problems for fisheries and aquaculture ,We know oceans capture and store carbon , as sea level increase affects rainfall pattern , effects on fisheries , global carbon cycle, Rising temperature causes ocean acidification affects mangroves and coral reefs[10].

Climate change and its effect on livestock:

Climate change has ill effects on dairy cows, In extreme heat yields low milk, heat stress disease and physical problems, Drought and floods causes low growth of grass and hay leading to less production of fodder for livestock which indirectly affect growth and reproduction of livestock[11].

Climate change and extinction of animal and plants:

Climate change caused extinction of huge mammals like mammoths, gigantic ground dwelling sloths, Armadillo in North America in the past. The heat stress, drought, flood, forest fires in the forest, sanctuaries in various parts of the world has killed the wild animals and plants, Climate changes effects forests, wetlands, habitat leads to vectors borne diseases leading to extinction of animals[12] nearly 700 species will lose habitat due global warming by 2070 in India -Myanmar border and may kill 35 percentage mammals and 29 percent birds[13].

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OUTBREAK OF COVID-19 AND ITS IMPACT ON INDIA

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Abstract:

COVID-19 is a highly transmittable and pathogenic viral infection caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) which emerged in Wuhan, China in December 2019 and spreads around the world. This new respiratory disease was named by the World Health Organization and was declared the outbreak as a Public Health Emergency of International Concern. This disaster is the most polarising global pandemic after the World War II which causes significant economic, social, political disruption, and afflicts civilization throughout human history in the world. It becomes an unprecedented challenge for India. As of May 15, 2020, the total confirmed cases in India are 79,321 and deaths over time are 2,649. To prevent the spill over of this pandemic Government of India has taken a variety of control measures including testing and treating patients, isolating, curbing huge assemblies, curfew, sustaining complete or partial lock down, surveillance and adhering strictly to lockdown procedures etc. In the present article the basic concept of COVID-19, and present scenario of India are discussed. In addition, the present study describes the potential impact of this pandemic and the consequent preventive measures like nationwide lockdown on socio-economy and environment with reference to India in the hope of providing a reference for forthcoming studies.

Keywords: COVID-19, Coronavirus, Pandemic, Outbreak, Impact

Introduction:

In late December 2019, when the entire world is enthusiastically looking forward to welcome "New Year – 2020", people on this earth could not envisage what danger is waiting for them in the coming year and what a big price world will have to pay for it. It is the greatest humanitarian challenge that the world has faced since World War II.

Let us take a look at the origin where this darkest chapter of human civilization started. In late December 2019, in Wuhan-China, a seafood wholesale market was linked to a group of patients with pneumonia of unknown reason (Hui *et al.,* 2020; Huang *et al.,* 2020; Lu *et al.,* 2020).On January 30, 2020 this pneumonia outbreak was stated as a Public Health Emergency of International Concern by WHO.

An unknown betacoronavirus was discovered using neutral sequencing in samples from patients with pneumonia (Zhu *et al.,* 2020). On February 11, 2020 this new virus was named SARS-Cov-2 by the International Committee on Taxonomy of Viruses (ICTV) and this new disease was named COVID-19 by WHO on the same day. Since the COVID-19 spreads across over multiple countries throughout the world within a short span of time and the illness is severe, therefore, it is considered as a pandemic rather than only an epidemic. It downwards the social mobility to a considerable extent. This disaster is the most polarising global pandemic after the World War II which causes significant economic, social, political disruption, and afflicts civilization throughout human history in the world.

Fundamentals of RNA virus attack:

L. E. Orgel, an Inorganic Chemist from Oxford argued that RNA is the first in the evolutionary race as it helps DNA to replicate and also it can synthesize protein. RNA (ribonucleic acid) is the genetic material of an RNA virus (Wagner and Hewlett, 1999). Coronaviruses are enveloped positive-sense RNA viruses, spreading generally among humans, other mammals, and birds which lead to respiratory, enteric, hepatic, and neurologic diseases (Weiss and Leibowitz, 2011; Masters and Perlman, 2013). A free primitive RNA in search of stability uses parasitic relationships with the smallest unit of life, a live cell for thermodynamic stability and in this process completely suppresses the genetics of the host cell. In a word, RNA virus is always looking for a cell to invade. Once inside, it reprograms the cell with its RNA and multiplies on mass, releases several copies of the primitive RNA. These newly formed RNAs contaminate new hosts. It's desire to replicate using the biomaterials of the host cell initially becomes rapid but the defence system of the host cell starts to build the desired immunity to fight back. In this process the energy expense of the host cell and the debris of the dead cell and the RNA creates edema and side effects in the host and if the host can sustain the initial attack then it can recover after few days. But under severe trauma most of the time such attack becomes fatal and most of the time the mutated versions of the original just following the diktat of survival of the fittest. This is the basics of RNA virus attack.

Discovery:

The journey of human coronaviruses started in the 1960s (Kahn and Mlntosh, 2005). Four coronavirus species — 229E, OC43, NL63, and HKU1 — are prevalentout of six species (Su *et al.,* 2016). Two other species named Severe acute respiratory syndrome coronavirus (SARS-CoV) and Middle East respiratory syndrome coronavirus (MERS-CoV) which cause incurable infection are developed from a zoonotic source (Cui *et al.,* 2019). The beta-coronaviruses are associated with severe illness and fatal disease out of four(alpha, beta, gamma and delta) coronaviruses subfamilies.

On the basis of genome sequence SARS-CoV-2 belongs to β-coronaviruses and it is distantly correlated to SARS-CoV (Zhou *et al.,* 2020). It is the seventh member of the coronavirus family.

COVID-19 and global health:

After its first outbreak COVID-19 has now become a major public health issue globally. The symptoms of COVID-19 infection may develop after a gestation period of 5 days (approximately) (Li *et al.,* 2020). The total time period from the commencement of COVID-19 symptoms to decease depends on many variables like position of the patient's resistant system, their age etc. This time scale is shorter for those comorbid patients who are over 70-years old as compared to younger ones (Wang *et al.,* 2020) who are suffering from cardiac, diabetes, chronic respiratory disease, and cancer etc. The respiratory infections including fever, fatigue, and dry cough are the common symptoms of this disease (Cui *et al.,* 2019; Zhu *et al.,* 2020).

Besides these, aches and pains, nasal bottleneck, runny nose, headache, haemoptysis, diarrhoea, dyspnoea, lymphopenia (Carlos *et al.,* 2020; Huang *et al.,* 2020; Ren *et al.,* 2020), rhinorrhoea, sneezing, and sore throat or sputum invention production (Lee *et al.,* 2003; Assiri *et al.,* 2013) may appear in some cases. It has been reported that despite of being a respiratory disease COVID -19 also affects other organs and tissues. Rothan *et al.,* have schematically reported the systemic and respiratory syndromes of this disease (Rothan and Byrareddy, 2020). Now a days the most worried report is that, in some cases, no symptom is developed in infected human body.

According to the recent report, the respiratory droplets and contact are the key carrier of COVID-19 virus transmission. A sick person generates the respiratory droplets through coughing, sneezing or speaking. Due to heavy weight these droplets rapidly drop on surfaces. If a person is within 1 metre of an infected person, or touches a virus containing surface, then touches his/her eyes, nose or mouth (contact transmission) before washing

hands then he/she can be infected readily.Therefore, it is necessary to keep a safe distance (more than 1 meter)from a sick person. There is also a possibility that COVID-19 can be passed on through kissing and close contact, including having sex with an infected person.

Present scenario in India:

Spiritual tourism, community gatherings and weddings are some vital probable coronavirus clusters in India - one of the most populated countries in the world. Let us have a look at the present scenario of India.

India's first case of COVID-19 was foundon January 30, 2020 in the state of Kerala. On March 12, 2020 the first coronavirus death of a 76-year-old man was reported in Karnataka. A sharp rise in the transmission started all over India from the month of March, 2020. People coming from the affected countries to India is the vital reason behind this sharp increase in the rate of infection. Some most vital virus hotspots of spreading of coronavirus in India were Sikh festival in Anandpur Sahib, Punjab (March 7, 2020) and Tablighi Jamaat religious congregation at Nizamuddin Markaz, Delhi (News, 2020).

Statistical analysis shows that in week 12, cases in India are lower than that of US, Germany and France. So, condition of India is better than most of these countries w.r.t infection. A comparative analysis of country wise confirmed coronavirus cases and death figures as on May 15, 2020 are shown in Figure 1 and 2.

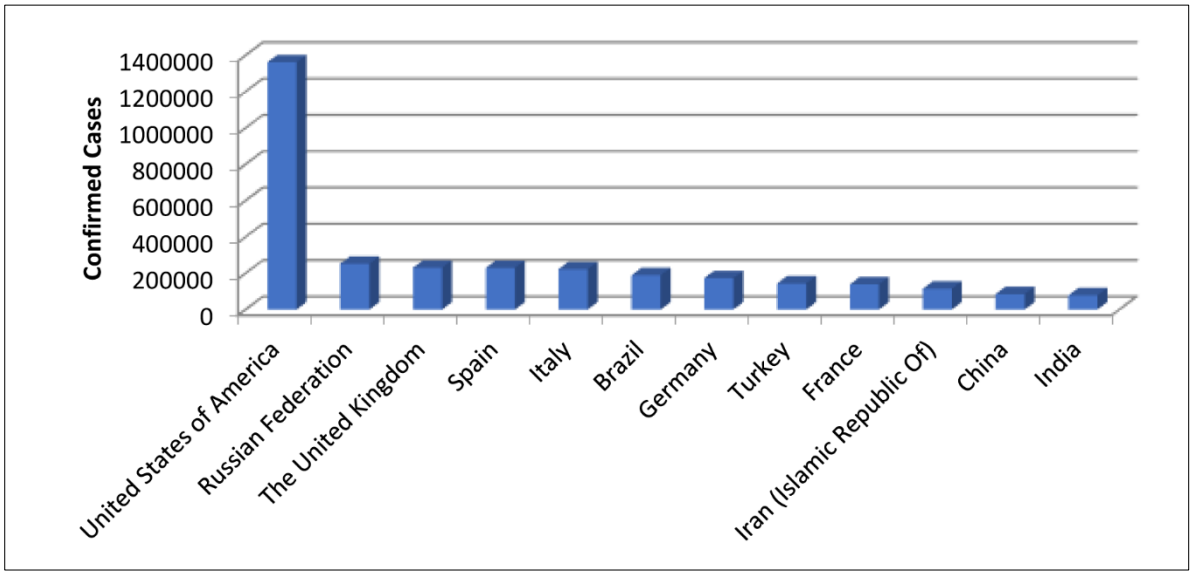

Figure 1: Country wise Confirmed Coronavirus Cases as on May 15, 2020 (Source: WHO 2020, Accessed date: May 15, 2020)

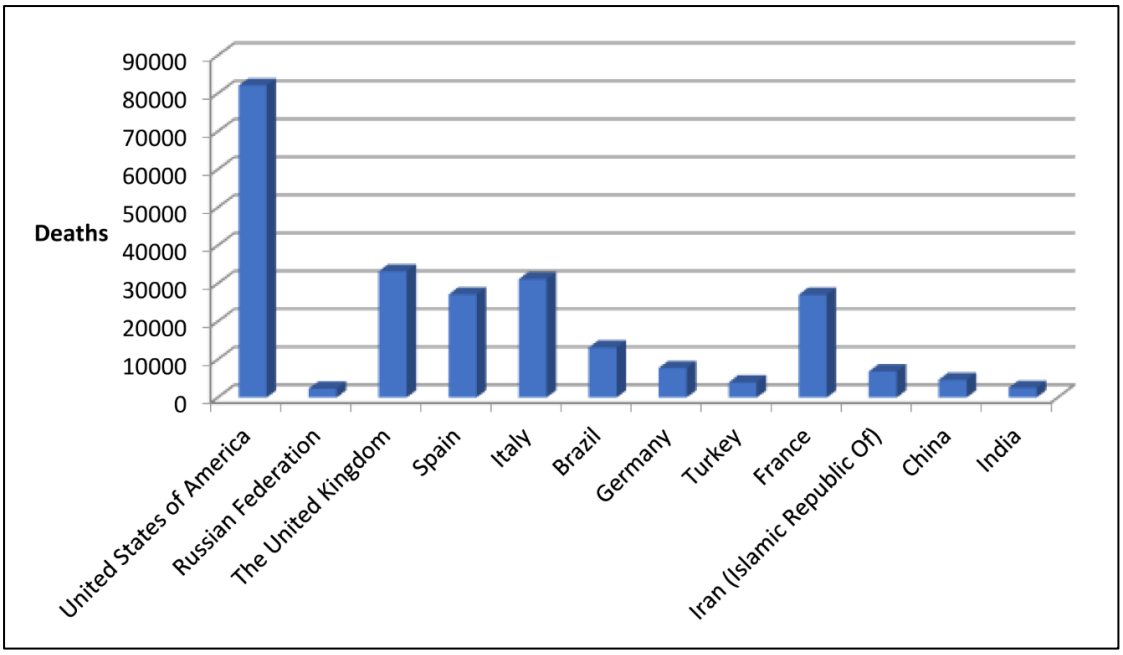

Figure 2: country wise Death Figures as on May 15, 2020 (Source: WHO 2020, Accessed date: May 15, 2020)

Globally it has been reported as on May 15, 2020, approximately 295,101 people died due to COVID-19 out of nearly 4,307,287 confirmed cases. However, in India, confirmed cases are 79,321 and deaths over time are 2,649 as on May 15, 2020. The statistics of India is shown in Figure 3. Of these, as many as 27919 patients have been cured till now taking the recovery rate to 34.06 percent.

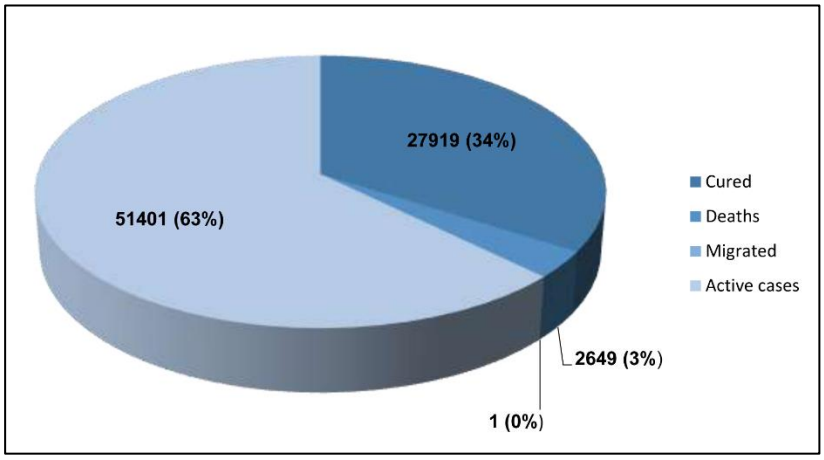

Figure 3: COVID-19: total confirmed cases, recovered, migrated and deaths in India as on May 15, 2020 (Source: https://www.mohfw.gov.in/seen on May 15, 2020)

In the past few days, COVID-19 cases across the country has been increased rapidly. A declining trend in the rate of progress of coronavirus cases (active cases and death toll) in

India has been observed in the month of April 2020- statistically it is linear but non-exponential (Kant *et al.,* 2020). In India, the rate of contamination is considerably lower as compared to the poorest affected countries which is reported to be 1.70 (Sinha, 2020). But unexpectedly, for the first week of May, 2020 India's day-to-day progress rate of infection is the highest among the 20 countries. During last seven days approximately 2500 new cases have been reported to be added every day in India (Thakur, 2020). The case detection rate including total number of infected people and total coronavirus deaths up to May 15, 2020 are shown in Figure 4 and Figure 5.

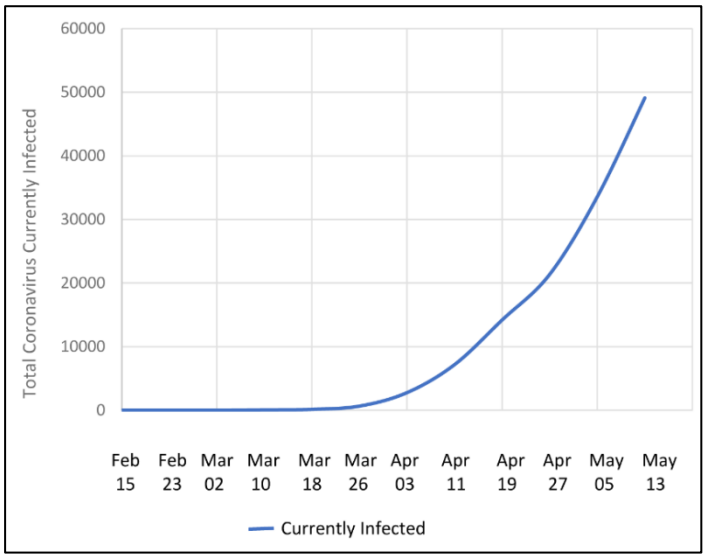

Figure 4: Active Cases (Number of Infected People) in India as on May 15, 2020 (Source: https://www.worldometers.info, Accessed date: May 15, 2020)

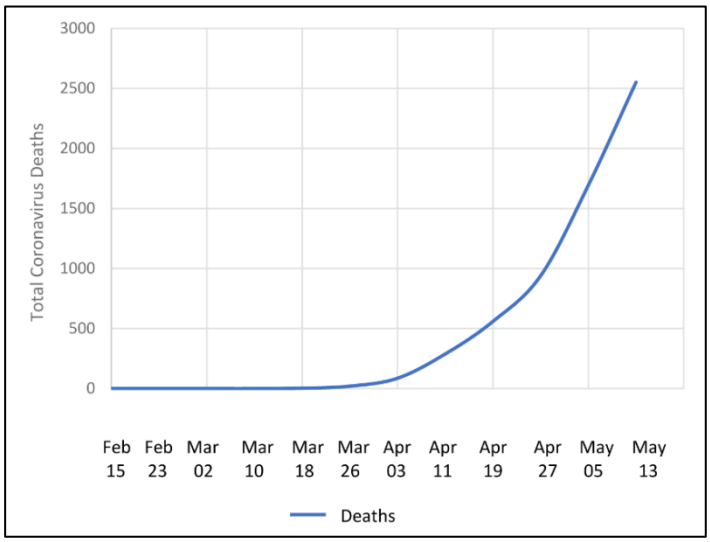

Figure 5: Total Coronavirus Deaths in India as on May 15, 2020 (Source: https://www.worldometers.info, Accessed date: May 15, 2020)

The state wise status of COVID-19 cases can be tracked on Home/Ministry of Health and Family Welfare website (www.mohfw.gov.in). It has been observed that the hotter and dehydrated areas are affected less than the cooler and tropical areas. However, as per as the experts' opinion is concerned, the number of COVID-19 cases would increase if diagnostic measures are increased in India.

To control the spread of this pandemic, various kind of precautionary actions including testing, isolating, curbing huge assemblies, curfew, sustaining complete or partial lock down, surveillance and adhering strictly to lockdown procedures have been taken by Government of India. However, due to large population and inaccessibility of specific medication & treatment option in India it is very tough to combat against this disease.

In brief, on March 24, 2020, to curb the spread of this pandemic, the Government of India ordered 21 days (25th March, 2020 – 14th April, 2020) countrywide lockdown (Regan *et al.*, 2020). The lockdown started in India when the number of active cases was quite low (~500) (Gettlement and Schultz, 2020). As a result, various types of institutions, and government offices are locked, malls, movies and factories are shutdown. Railway services, commercial passenger flights, other vehicles transportations are postponed. Although initially this response taken by India was appreciated by WHO, but the present situation in India is agitating.

A significant low progress rate of infections in India had been observed towards the end of the first phase of lockdown (Gupta, 2020). On April 14, the countrywide lockdown was prolonged till May 3. After April 20, the areas where the spread had been controlled were given conditional relaxation (Bhaskar, 2020). On April 16, on the basis of rate of growth of infection lockdown zones were classified into three zones – (i) Red (high growth rate of infection), (ii) Orange (some infection) and (iii) Green (infection free area) (BBC News, 2020). The State governments in India had started mass "pool testing" in red zones to decreases the required testing time of large swathes of the population.

This prolonged lockdown has been continued till May 17. However, on the basis of confirmations of the infection, significant relaxations have been given across the three zones as mentioned above (The Hindu, 2020). During lockdown period all the air travel, running of trains, metro and inter-state buses for public transportation are banned. However, banks, ATMs, petrol pumps, hospitals and grocery shops etc important amenities will remain open according to government notice. Medicines and all indispensable supplies will also be accessible.

Impact on India:

The country is trying to spill over the outbreak till now. Critics have identified this outbreak of COVID-19 as an outcome of hyper-globalisation or starting of de-globalisation. This pandemic primarily generates a health disaster which eventually becomes the source of socio-economic disaster. Many experts have already called this a Black Swan event for the global economy.

COVID -19 has a distressing effect on human life. It also plays a significant role to slowdown the economy of the world including India. Due to this lockdown the financial activities in India have been ceased entirely. International trade and commerce have come to a standstill condition due to the shutdown of establishments, markets and closure of national borders. As a result, the supply chains have been disrupted extensively. Consequently, investment, employment, income and consumption are affected significantly. And there is an interruption in three interrelated matters- work, wages/income and food – for all people in India. In fact, the degree of the financial effect depends on many variables like extent and harshness of the health crisis, extent of the lockdown etc.

Indian economy is expected to be influenced mostly by COVID-19. The informal workers, micro, small and medium enterprises (contributor of 30% of India's GDP), financial markets and organizations, agriculture segments including farmers and the freelance workers are affected mostly in the absence of transportation and entree to shops (Kishore, 2020). How COVID-19 has created a marked effect on economy that has been mentioned in CMIE report. 30.9% increase in the unemployment rate has been found in the urban areas of India while overall rate increases to 23.4% (Sreevatsan, 2020). Approximate 140 million people have become unemployed during this lockdown period (Business Today (2020). It has been reported that the redundancy rateincreases from 7% - 8% to 23% - 24%, the labour force contribution rate decreases from 43% to 35.5% and a reduction in income occurs for more than 45% of households across the nation (Vyas, 2020) in comparison with the last year. A downfall of India's growth with the lowest figures has been observed due to COVID-19 for the first time for fiscal year 2021 during the last three eras (Economic Times, 2020; The Hindu, 2020). However, for the financial year 2021-22, highest growth rate at 1.9% (IMF projection) has been observed in India among G-20 nations (Kumar, 2020). Three fiscal situations in India have been reported by McKinsey model to get an overview of the possible economic consequences and possible interferences (Gupta and Madgavkar, 2020). UNCTAD estimates that the global economy will lose between $1 trillion and $2 trillion in 2020 due to COVID-19 (Goyal, 2020). So, ultimately, we can say that the outbreak of COVID-19 and consequent lockdown in India will be able to create a significant

impact on the economy mainly on consumption which is the biggest component of GDP. Experts have predicted one-half a percentage point dropping of global GDP growth for 2020. According to the Ministry of Statistics, in comparison with the previous year, for the financial year 2021, a 24% GDP contraction for first quarter (April to June) has been observed. India's quarterly GDP growth in 2020 due to COVID-19 is shown in Figure 6.

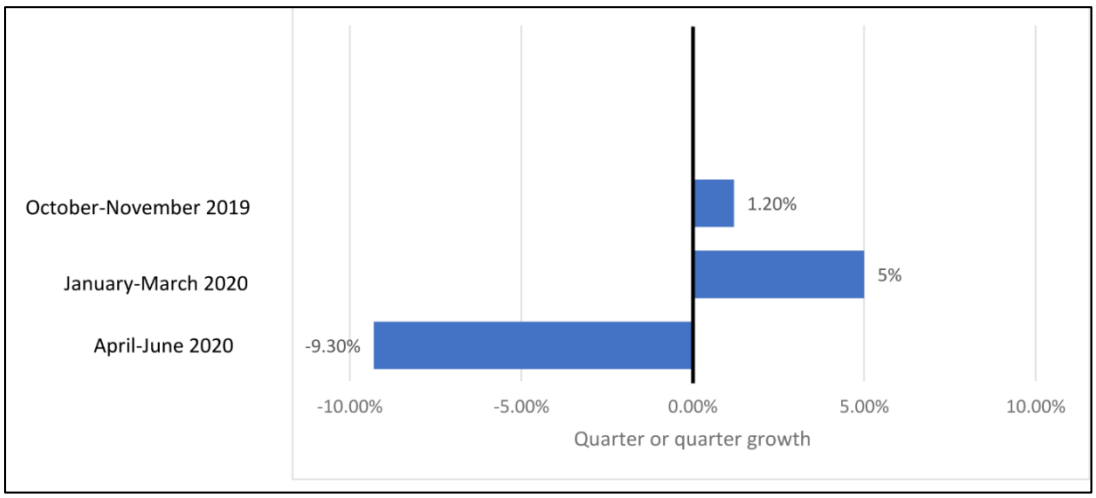

Figure 6: India's quarterly GDP growth in 2020 due to COVID-19
(Source: https://www.statista.com/statistics, Accessed date: May 15, 2020)

It has been anticipated that about US$4.5 billion Indian economy will fall daily during the first stage lockdown (The Hindu, 2020). According to the recent statistics, to combat against this disease 2.2 to 4.8 percent of GDP will be required by India. However, these assessments can differ depending on the extent of lockdown and the rate of growth of this pandemic in India. It has been studied that the economic discrepancy would increase to 4.3 percent of GDP compared to a budgeted target of 3.5 percent when there is no drop in GDP (Balajee *et al.,* 2020).

This prolonged lockdown and associated troubles have a great impact on the agricultural activities and the essential supply chains. These will be affected through several networks: input distribution, collecting, procurement, transport hurdles, promotion and dispensation, scarcities of fertilizers, veterinary remedies and other involvements. The poultry farmers are facing a huge problem due to spreading of false news that chicken carry the coronavirus.The milk sales have also been dejected during this lockdown period. The dairy farmers are throwing away the milk in the drains due to lack of demand. Overall, the food suppliers have been interrupted by this lockdown which ultimately leads to generate a nation-wide food crisis in India (Biswas, 2020; Yadav, 2020). Producers and suppliers are affected by the weakening demand for fresh products, poultry & fisheries products due to the closures of restaurants and transport blockages. Overall, the deficiencies and increase

in the price of the food items have created a very threatening situation for the existence of the poor and middle-class people in India (Hussain, 2020).

The informal workers, daily wage workers, migrant workers, self-employed and those below the poverty line have been reported to be extremely affected (Das, 2020). A large number of migrant workers become jobless in India as a result of closure of factories and workplaces and they are compelled to return to their home (Sur and Westcott, 2020). Hence, the day to day life of the entire human society is affected by COVID-19 to a considerable extent. At the same time, the consumption demand in India has been completely distorted.

Among various sectors, five sectors namely vehicles, trade, aviation, financials, and real estate have suffered the most and continue to suffer (Kumar, 2020). Besides these, MSME which contribute around 30% of India's GDP, financial markets, banks, metal industries, automobiles and ancillaries, textiles, electricity, mining, food product companies, logistics, tourism & travel related industries, drugs, pharmaceuticals, electronic goods, hospitality and related segments have been largely affected by fiscal disorder associated with COVID-19. A severe disruptive effect will be observed up to 53% of businesses in India by COVID-19 (Mukherji, 2020). The employees of various businesses have become jobless. Sometimes their salaries are also reduced (Goyal, 2020). According to The Centre for Asia Pacific Aviation, the Indian aviation industry will post stunning losses worth nearly $4bn this year. According to the International Air Transport Association, in comparison with March, 2019, Indian domestic air passenger traffic fall by 11.8% in March, 2020. The World Travel and Tourism Council has projected a risk of 12-14% of the jobs in the travel sector because of the 25% fall of the air passenger traffic. 50% to 70% decrease in output is found in the tourism sector. Due to COVID-19 pandemic along with the lockdown the total funding amount of Indian startup in Q1 2020 is 50% lower than the Q4 2019 (Mittal, 2020). On March 23, 2020 a worst loss in history has been found by the Stock markets in India (The Indian Express, 2020). The S&P BSE Sensex decline 3934.72 points to settle at 25981.24 while the broader NIFTY 50 diminished 1135.20 points to settle at 7610.25. On March 25, the investor wealth is enhanced by US$66 billion (Shah, 2020). A study by Crisil Research has shown that there will be a 50% fallout of passenger vehicle sales as a result of COVID-19 (News 18, 2020). As per their report GDP growth will be minimized to 1.8 percent this fiscal.

Overall, an economic collapse has been observed everywhere like restaurants, live event industries, hotels, and various commercial stores etc. In March 2020, a 23% reduction in market capitalisation has been found in the enlisted companies of National Stock Exchange (NSE). Similarly, the BSE S&P Sensex lose 23% of its value in this month.

In the first five days of May, the total power consumption of India drops over 20% as compared to the previous year. This fall is caused by the reduction in the economic activity associated with COVID-19, according to Power System Operation Corporation (POSOCO). In our country, the key source of power generation is coal. Due to cessation of financial activity resulting from a prolonged nationwide lockdown, a seven-month drop of Coal India Ltd.'s shipments in April has been reported (Mirchandani, 2020). In India, oil demand has been collapsed by almost 70% year on year (Sundria and Chakraborty, 2020). Movement of trucks on the roads is running at 10% of normal levels (Sundria, 2020). A reduction in rail freight by 36% year on year over the last seven days has been reported (Rail Drishti).

The economic emergency is the final impact of countrywide lockdown everywhere in India. This lockdown drops the GST collection, and generates extreme stress all over India.To overcome this financial crisis, some states have allowed liquor shops to open up because about one-fourth of total income of states can be made up from the income of the alcohol sale. Arising of some medical issues for some drinkers associated with this lockdown and subsequent unavailability of alcohol is another reason behind the opening up of liquor shops. In Kerala and Meghalaya, attempt to suicide cases due to the non-availability of liquor have already been reported. So, few states have given permission to open liquor shops partially. However, on May 4, 2020, the Govt. of India has given permission to run the alcoholic shops with certain limitations (India Today, 2020).

Although this pandemic has caused a global reduction in socio-economic activity, it has an unexpected positive impact on the environment. An abrupt reduction in greenhouse gases (CO_2, CH_4 etc) as well as contaminant gases (CO and NO_2) has been observed due to the closure of trades, transport networks and businesses recreational units, offices and businesses. The air quality is improved and the ecosystem has started to recover due to minimization of toxin removal resulting from negligible activity from industrial sites, factories and construction sectors. The ozone layer has also started to revitalize due to considerable decrease in the pollution level.

Interestingly, some incredible changes are found in India after this COVID-19 lockdown. The sky unexpectedly becomes a rare, intense blue in some polluted cities of India. Central Pollution Control Board (CPCB) has reported a substantial improvement in air quality in major seven cities in India during the lockdown period. Delhi, Bengaluru, Kolkata and Lucknow have seen their average AQI staying within two digits. The rare South Asian River Dolphins have been found at various Ganga Ghats of Kolkata due to the lowering of the pollution level in water. Amid lockdown, a huge number of migratory birds' flamingos have been seen in Mumbai. The most unpredictable fact is that for the first time in eras the Ganga water of Haridwar, Uttarakhand has been reported to be suitable for drinking (Goswami, 2020). According to CPCB, the present average quality of water of the

Ganga becomes suitable for bathing and distribution of environment and fisheries (Saigal, 2020).

Overall, this pandemic plays a dual opposing impact on human civilization – on one hand it has a distressing effect on survives, health services, works and psychological health, and on the other hand it has an outstanding beneficial impact on environment.

Conclusions:

Presently, we are living through a unique biopsychosocial crisis. It downwards the social mobility to a considerable extent. This disaster is the most polarising global pandemic after the World War II which causes significant economic, social, political disruption, and afflicts civilization throughout human history in the world. COVID-19 is a great challenge for India which ultimately results in deep privations, starvation and death among people having lower economic background. As of now no specific medication and vaccine are available for COVID-19 treatment. On the other hand, the risk of future pandemics increases due to various types of environmental degradation. Therefore, post COVID period to preserve the environmental sustainability it is essential to diminish the harmful effects of human activity on the environment. It is necessary to implement the environmental, transport and industry protocols in a better way. We shall have to preserve the natural resources and sustainable development. We have realized from this pandemic that human and planetary health is intimately interconnected. The choice is ours. We all are hopeful that we shall overcome this hard time. We must be able to fight with this mammoth pandemic with a healthy body and a strong mind. Amidst all the disruption and turmoil, a hopeful reminder remains that "We shall overcome".

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MOSQUITO LARVICIDAL POTENTIAL OF PSEUDOMONAS SPP. ISOLATED FROM RHIZOSPHERE SOIL

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Abstract:

Mosquitoes are mainly responsible for the transmission of infectious diseases like dengue, malaria and chikunguniya. Controlling of mosquito for public health is important. Presently use of chemical pesticides is considered as one of the preventive method to control mosquito population. But this method is hazardous and adversely affects the human beings. Hence to control the mosquito population biological means can be use as an alternative to chemical pesticides. The bacteria derived crude metabolites could form good basis towards the formulation of efficient, eco-friendly mosquito control agents. In the present study *Pseudomonas spp*. were isolated from rhizosphere soil. Antilarval activities of isolates were determined by using third instars larvae of mosquitoes. Out of 50 isolates 20 isolates showed antilarval activity. Isolates P7, P10 and P15 have good activity and showed 100% larval mortality as compare to other isolates.

Keywords: Mosquitoes, Antilarval activity, *Pseudomonas* spp.

Introduction:

Over 2500 different species of mosquitoes are present throughout the world. The studies showed that in India three vector borne diseases namely Malaria, Dengue and Chikungunya are more prevalent (Brammacharry and Paily, 2014) Mosquitoes are considered as large group of insects present throughout the temprate and tropical regions and even beyond the Arctic circle of the world (Harbach, 2007; Sivakami *et al.*, 2017) They belongs to family *Culicidae*, order *Diptera* and are divided into two subfamilies and 112 genera. At present, a total of 3,540 recognized mosquito species are recorded in the world. Among this, the Indian mosquito fauna includes 393 species which is divided among 49

genera and 41subgenera. Most of the important disease vectors are the members of *Anopheliae* and *Culicidae*. In India, 31 species are currently recognized for transmitting various mosquito borne pathogens (Bhattacharya *et al.*, 2014).

The commercial repellent spray and mosquito coils use Diethylmetatoluamide (DEET), Methoprene, Briquet, Malathion and Pyrethrum, usage of such chemical agents is proven disadvantageous (Katayama, 2008) Presently use of chemical pesticides is more common to control mosquito population. However due to development of resistance and environmental concern it creates limitations for their use (Hemingway and Ranson, 2000) as chemical pesticides adversely affect non-target population also (Milam *et al.*, 2000).

Development of insecticidal resistance in mosquito populations, inhibition of non-target beneficial insects and contamination of food and drinking water sources leads to damage to the biodiversity and are major drawbacks of over use of chemical insecticides. At the same time genetic alternations are also contributing to increase in the number of resistant variety of mosquitoes and reducing the effectiveness of insecticides (Chevillon *et al.,* 1999).

To control the mosquito population biological means can be use as an alternative to chemical pesticides because microbial community in the plant rhizosphere soil is highly dynamic in nature which compete for water, nutrients, space and also help in the growth and ecological fitness of their host. The diversity and predominance of microbial population depends on number of biotic and abiotic factors of particular niche. Plant development stage and soil type have been indicated as a major factors determining the composition of rhizosphere microbial communities (Broeckling *et al.*, 2008). The rhizosphere microflora includes bacteria, fungi, nematodes, protozoa, algae and microarthops (Raaijmaker *et al.*, 2009). Among these *Pseudomonas* species and *Bacillus* species are well documented bacterial populations which involve in biostimulation, biofertilization and biocontrol activities. Thus, rhizosphere zone acts as bioresource for bioactive substances such as antibiotics, biosurfactants, enzymes and osmoprotective substances (Berg *et al.*, 2005).

Pseudomonas is large group of aerobic, nonsporing, Gram- negative bacilli, motile by polar flagella. They are ubiquitous, mostly saprophytic, being found in water, soil and other moist environments. Some of them are pathogenic to plants, insects and reptiles. It is non capsulated but many strains have a mucoid slime layer. *Pseudomonas* produces a number of pigments the best known being pyocyanin and fluorescein. Pyocyanin is bluish green phenazine pigment soluble in water and chloroform. Fluorescein (pyoverdin) is a greenish yellow pigment soluble in water but not in chloroform. Species of the genus *Pseudomonas* show remarkable metabolic and physiological versality, enabling colonization of diverse

terrestrial and aquatic habitats (Palleroni, 1992) and produce a variety of metabolites which posses a major role in biocontrol of phytopathogens and mosquitoes (Haas and Defago, 2005).

Material and Methods:

Collection of soil sample:

Total 10 soil samples were collected from different places of Dr. PDKV Akola and Botanical garden of Shri Shivaji College, Akola. About 10cm rhizosphere soil particles loosely adhering to the roots were gently teased out and the soil was aseptically transferred to the sterile polythene bags with the help of sterile spatula. Samples were collected from the rhizospheric area of following trees. 1) Palm 2) Umber 3) Jamun 4) Custard apple 5) Ramphal 6) Almond 7) Chafa 8) Ashoka 9) Tulsi 10) Datura.

Isolation and identification of *Pseudomonas* species from soil samples:

All the soil samples were added to conical flasks and shaken with 100ml sterile distilled water to obtain standard soil suspension. From this, soil suspension was serially diluted and plated on selective medium Pseudomonas isolation agar and Cetrimide agar. Then plates were incubated at 37 ^{o}C for 48 hrs. Pure culture slant of each isolates were prepared for further use. All the isolates were subjected to biochemical characterization according to Bergey's Manual of Determinative Bacteriology. Gram characters and biochemical tests such as Nitrate reduction test, Gelatin liquefaction test, Catalase test, Oxidase test, IMViC test, Sugar test (Glucose, Lactose and Mannitol) were performed to identify all the isolates.

Production of metabolite from isolates:

Isolated bacteria were inoculated in sterile nutrient broth and incubated for two weeks. The enriched broth was centrifuged at 10, 000 rpm for 20 min to obtain the cell free supernatant.

Protein estimation of crude metabolite by Lowry's method:

Culture of *Pseudomonas* species was inoculated in 50ml nutrient broth and flasks was incubated on a rotary shaker at 30^{o}C and 180 rpm for 48 hrs. The cell mass was harvested by centrifugation at 10,000 rpm for 15 min and cell free supernatant was transferred to fresh sterile tubes. Extra cellular protein concentration in cell free supernatant was estimated by Lowry's method (Lowry *et al.*, 1951)

Determination of Larvicidal activity:

Isolated bacteria were inoculated in sterile nutrient broth and incubated for one week. The enriched broth was centrifuge at 10,000 rpm for 15 minutes. The cell free supernatants and solution with pellets obtained was used for testing its toxicity towards mosquito larvae. Third in star larvae of mosquito species (*Aedes aegypti* and *Culex quinquefasciatus*) were transferred to glass plates containing 20ml of solution of CFS and solution with pellets. 10 larvae were added into each bioassay plate as well as the control which contains distilled water. Larval food containing yeast and dog biscuits (1:4by weight) was sterilized by autoclaving at 121°C for 15 min and added in fine powder form to the bioassay plate containing larvae. Further bioassay plates were incubation at room temperature. The mortality rate of larvae was recorded after 24, 48 and 72hr from exposure and checked for mortality, if any, using Abbott's formula, (Abbott, 1925 ; Mulla *et al.*, 1975)

$$\text{Corrected percent mortality rate} = \frac{\text{No. of dead larvae}}{\text{No. of larvae tested}} \times 100$$

Results and Discussion:

Mosquitoes which come under insects are most destructive group which causes dreadful diseases in human beings. As far as their control is concerned in Indian conditions it is difficult because of unhygienic conditions. Method commonly used for control are the chemical methods, but it is documented that as this insect develops resistance often for the chemicals, this methods are not full proof methods. (Brown *et al.*, 1964; Brattsten *et al.*, 1986; Hemingway *et al.*, 2000).

In the present study total 50 isolates were obtained from different soil samples which were identified by standard conventional methods as per the Bergey's Mannual of Determinative Bacteriology (Table 1). All the isolates belong to *Pseudomonas spp.* shows fluorescence pigment production in NB medium and bluish green colony formation when cultured in Pseudomonas isolation agar medium. This result was similar to the finding of (King *et al.*, 1954).

Presence of protein could also be the reason behind the presence of activity as this could be the possibility of type of exotoxin in this regard the cell free supernatant of crude metabolite was checked for presence of protein content by Folin –Lowry method (Fig.1). It was observed that the isolate P10 and P7 contains more amount of protein than other isolates this also relates to Pranjali *et al.* (2016) who reported the presence of exotoxin responsible for the activity.

Table 1: Cultural, morphological and biochemical characteristics of prominent isolates

Isolates	**P7**	**P10**	**P15**
Size(mm)	2.0	2.0	2.0
Shape	Short rod	Short rod	Short rod
Colour	Greenish yellow	Greenish yellow	Bluish green
Opacity	Opaque	Opaque	Opaque
Margin	Entire	Entire	Entire
Elevation	Convex	Convex	Convex
Texture	Smooth	Smooth	Smooth
Motility	Motile	Motile	Motile
Gram characters	Gram - ve	Gram - ve	Gram - ve
IMViC Test			
Indole	-ve	-ve	-ve
MR	-ve	-ve	-ve
VP	-ve	-ve	-ve
Citrate	+ve	+ve	+ve
Enzyme test			
Catalase	+ve	+ve	+ve
Oxidase	+ve	+ve	+ve
Gelatinase	+ve	-ve	+ve
Amylase	+ve	+ve	+ve
Nitrate Reductase	+ve	+ve	+ve
Urease	+ve	+ve	+ve
Sugar fermentation			
Glucose A/G	-/-	+/-	+/+
Lactose A/G	-/-	-/-	-/-
Mannitol A/G	+/+	+/+	+/+
Name of isolates	*Pseudomonas spp.*	*P. fluorescence*	*P. aeruginosa*

The larvicidal potential of each isolate was checked with the crude cell free supernatant obtained from the previously incubated medium. The third instar larvae was taken and activity of *Pseudomonas* species was determined by using mosquito larvae

incubated along with the different concentrations of CFS broth. Out of 50 isolates 40% of *Pseudomonas* spp. showed larvicidal activity in the bioassay (Fig.2.) while 60% were failed to show any activity.

The larvicidal activity was checked over the period of 72hrs. (Fig.3). It was observed that percentage mortality of P1-90%, P2-70%, P3-60%, P4-80%, P5-40%, P6-50%, P7-100%, P8-70%, P9-60%, P10-100%, P11-60%, P12-30%, P13-80%, P14-90%, P15-100%, P16-90%, P17-80%, P18-80%, P19-70%, P20-70%.

Fig. No.1 Estimation of crude protein from cell free supernatent

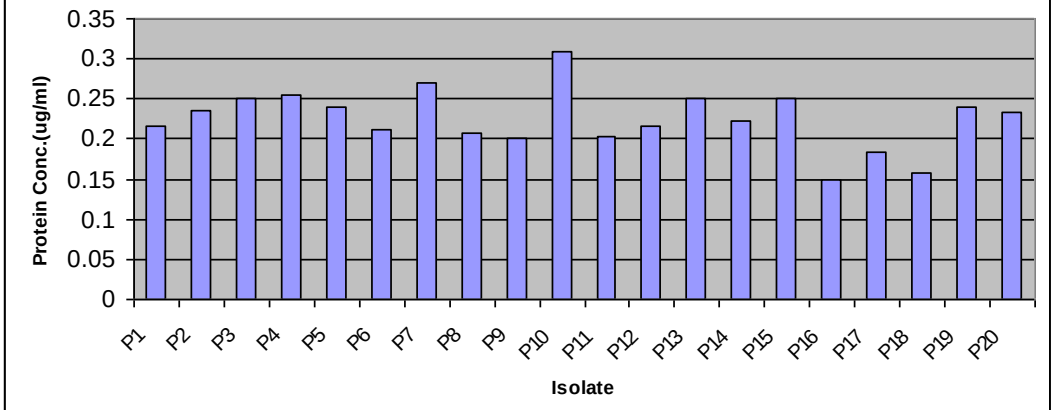
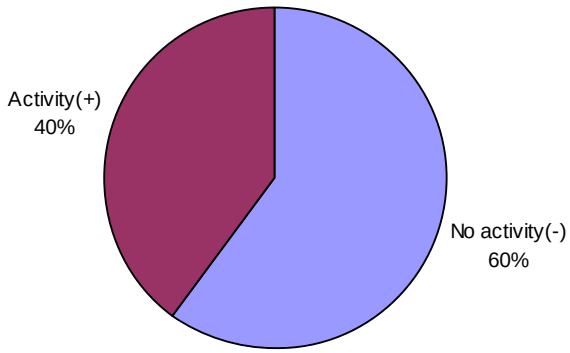
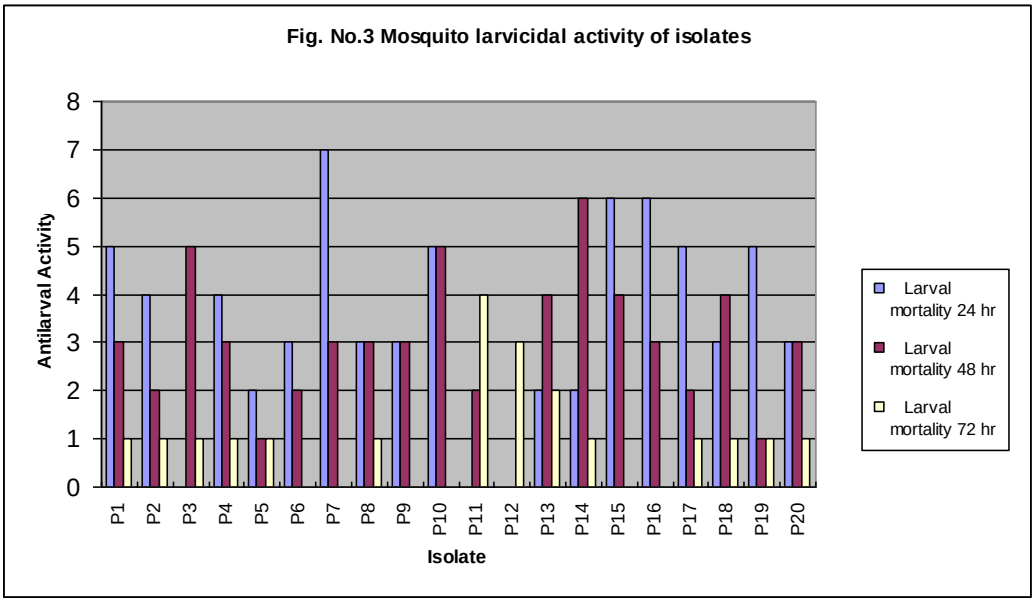
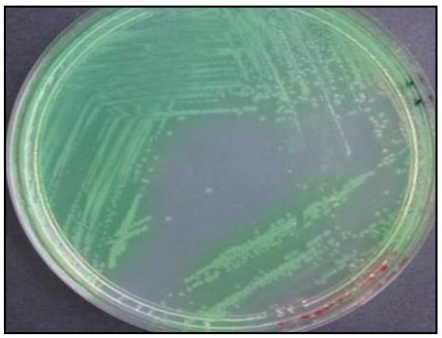


Fig No. 2 Potential of Pseudomonas isolates showing larvicidal activity

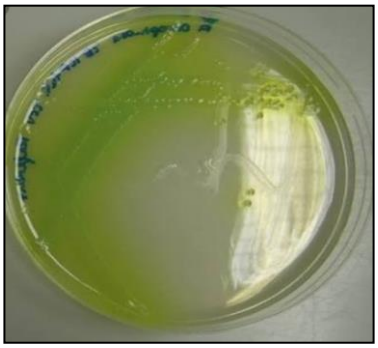


Among all isolates it was found that within 48hrs most of the larvae were found dead. But crude metabolite from isolate P7, P10 and P15 were most prominent in activity as all larvae tested were dead within 48hrs. Prabakaran *et al.* (2002) also reported that the larvicidal formulations of extracellular supernatant of *Pseudomonas fluorescens* showed maximum larvicidal activity against *Aedes aegypti* larvae when compared to the larvae of *Anopheles stephensi* and *Culex quinquefasciatus.*

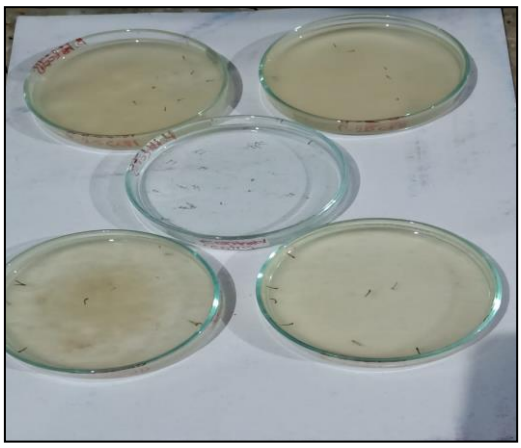




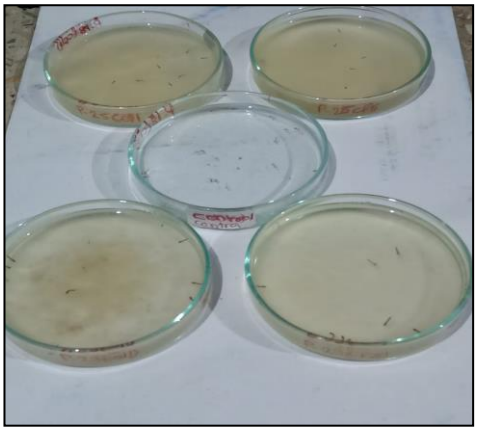
***P. aeruginosas* on Cetrimide agar**



***P. fluorescens* on Pseudomonas isolation agar**



Activity (Before)



Activity (After)

Conclusion:

In the present study, about 40% *Pseudomonas* isolates showed appreciable *in vitro* larvicidal activity. These *Pseudomonas* species would have producing crude metabolites which are mainly responsible for larvicidal activity. The most of the larva found to be killed in the time duration of 48hrs in the plates containing crude metabolite. The crude

metabolites of *Pseudomonas* species P7, P10, and P15 have more larvicidal activity as it gives more percentage of mortality than other isolates of *Pseudomonas* species within 48hrs. Hence further studies on these biological metabolite produced by these *Pseudomonas* species could form good basis towards the formulation of efficient, eco-friendly mosquito control agents in near future.

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ANTIFUNGAL ACTIVITY OF *AZOTOBACTER CHROOCOCCUM* SR-14 ISOLATED FROM SOYBEAN RHIZOSPHERE SOIL

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Abstract:

Nitrogen fixing bacteria have a great potential to benefit plant growth and development through the production of plant growth promoting substances. Biocontrol of fungal phytopathogens is one of the important activities of these microbes contributing for disease suppression and yield improvement. The present study was designed to isolate and characterize *Azotobacter* spp. from soybean rhizosphere, and to evaluate their antifungal activity against *A. niger, A. parasiticus, A. flavus, A. fumigatus, F. oxysporum, F. moniliformis, Microsporum cannis, Trichophyton rubrum,* and *Alternaria* sp using agar well diffusion assay. A total of 23 isolates from soybean rhizosphere, belonging to Azotobacter genus, were isolated and screened for *in vitro* antagonistic activities against fungal pathogens. The potential strain SR-14 was identified as *Azotobacter chroococcum* on the basis of morphological and biochemical criteria. The strsain SR-14 inhibited the growth of six pathogens with highest inhibition towards *Fusarium moniliformis* (24mm) and *Aspergillus niger* (19 mm).

Keywords: Azotobacter, nitrogen fixation, Biocontrol, Fusarium, Aspergillus

Introduction:

Fungal phytopathogens pose a serious threat to agriculture as they contribute for significant losses of agriculturally important crops. India is an agrobased country where most of the population depends on agriculture. The intensive agricultural practices in developing areas are based on irrigation and fertilization that needs high economic investments. However, the prevalence and severity of outbreaks caused by virulent fungal phytopathogens have increased since last two decades and are recognized as emergent threats to food security worldwide (Fisher *et al.,* 2012; Santini *et al.,* 2013). In addition to

this, uncontrolled use of chemical pesticides used to control these pathogens is having more undesirable effects on soil and quality of crop yield. This intensifies the need of ecofriendly and biobased active preparations that can cause disease suppression effectively and improve the crop yield.

Azotobacter is a group of Gram negative, free-living, nitrogen fixing aerobic bacteria inhabiting in the soil and belonging to the family Azotobacteriaceae. They exert advantageous effect on the plant growth and yield through the production of biologically active substances, instigation of rhizospheric microbes, production of phytopathogenic inhibitors, alteration of nutrient uptake and eventually magnifying the biological nitrogen fixation (Lenart, 2012). The studies on effect of Azotobacter *chroococcum* on crop production showed its importance in improving plant nutrition and amelioration of soil fertility (Kurrey *et al.,* 2018). The role of Azotobacter in crop protection and disease suppression was studied by many researchers. Maheshwari *et al.* (2012) reported strong antagonistic activity of the strain TRA2 of *A. chroococcum* from wheat rhizosphere against root rot fungus *Macrophomina phaseolina* and *Fusarium oxysporum.* Similarly, Akram *et al.* (2016) showed the significant reduction in disease incidence of *Meloidogyne incognita* in presence of *A. chroococcum*. The mechanisms that contribute for the disease management include the production of siderophores, antimicrobial substances and toxins. Keeping these aspects in view, the present study was planned to isolates Azotobacter species from soil and to recognize their role in Biocontrol of some common fungal phytopathogens

Materials and Methods:

Collection of Soil sample:

Soil samples were randomly collected from rhizosphere region of agricultural fields cultivated with soybean crop from Nanded region of Marathwada, M.S., India. The healthy crop plants were uprooted and the soil adhered with the root is transferred to sterile polythene bag and immediately transported to the lab. The soil samples were stored at 4°C till further processed.

Enrichment and Isolation of Azotobacter species:

1g air dried soil was added in a flask containing 100 ml Azotobacter broth (HiMedia, Mumbai, India) medium. The flask was incubated at room temperature (30±2°C) for seven days and observed for pellicle formation. At the end of incubation, a loopful of pellicle from enriched broth was streaked on the surface of Azotobacter agar medium plates. The plates were incubated at 30°C for 48 to 72 hrs and morphologically distinct, well isolated colonies

of Azotobacter were transferred on the slants of Azotobacter agar medium. Total 23 isolates were selected and maintained on Azotobacter agar slants at 4°C. Each isolate was characterized by Gram staining and motility.

Test fungi:

A. niger, A. parasiticus, A. flavus, A. fumigatus, F. oxysporum, F. moniliformis, Microsporum cannis, Trichophyton rubrum, and *Alternaria sp* were collected from Fungal Culture Collection Lab of School of Life Sciences, SRTM University, Nanded.

Screening of Azotobacter isolates for antifungal activity:

The isolates were inoculated in the antifungal metabolite production medium (Bhosale *et al.,* 2013) and incubated on orbital shaker at 30°C for 4 days at 100 rpm. After incubation, the broth cultures were centrifuged at 8000 rpm for 10 min and the cell free extracts were obtained. The 0.1 ml spore suspension (in 10%tween 80) of selected fungi was aseptically spread on sterile potato dextrose agar plates. A well (5 mm) was made with the help of flame sterilized cork borer in the centre of agar surface and 0.1 ml of cell free extract of *Azotobacter* sp was placed individually in well. The plates were kept in refrigerator for 20 min for diffusion. After diffusion, the plates were incubated at 30°C for 48 hrs to observe zone of inhibition. Nystatin (50µg/ml) was used as a standard antifungal antibiotic. The isolate SR-14 showing inhibition of maximum test pathogens was selected as potential strain for further studies.

Biochemical characterization of Azotobacter SR-14:

The Azotobacter SR-14 was further identified as per the criteria given in Bergey's Manual of Systematic Bacteriology (Staley *et al.,* 2005). The tests included cyst formation ability, pigmentation, nitrate reduction, amylase and catalase activity and utilization of carbon sources.

Temperature and salinity tolerance of Azotobacter SR-14:

The isolate was inoculated individually in six flasks containing Azotobacter broth medium and the flasks were incubated for 24 hrs at 20°C, 25°C, 30°C, 37°C, 45°C and 50°C temperatures to study the growth of SR-14 at different levels of temperatures. Similarly five sets of Azotobacter broth were prepared which were supplemented with 0.5%, 1%, 1.5%, 2% and 2.5% NaCl and each flask was inoculated with SR-14. At the end of

incubation period the growth was monitored in terms of optical density at 600 nm against un-inoculated Azotobacter broth as a control blank.

Results and Discussion:

The strain of *A. chroococcum* SR-14 showed greater antifungal potential against phytopathogenic fungi as *A. parasiticus, A. niger, A. fumigatus, A. flavus, F. oxysporum* and *F. moniliformis*. The *F. moniliformis* was observed to be most sensitive to antifungal effect of *A. chroococcum* followed by all tested species of Aspergillus genus whereas *Alternaria, Trichophyton rubrum* and *Microsporum canis* didn't showed sensitivity response to *A. chroococcum* metabolites compared to other fungal pathogens (Table 1). Many researchers reported antifungal potential of Azotobacter sp isolated from different soil samples. Chetverikov and Loginov (2009) reported antagonistic activity of *A. vinelandii* against *F. culmorum, F. gibbosum, F. graminearum, F. nivale, F. semitectum, F. solani, F. avenaceum* and other fungal pathogens such as *Bipolaris sorokiniana* and *Alternaria alternata*. Bhosale *et al.* (2013) reported highest inhibition of *Fusarium moniliformis* by *Azotobacter vinelandii AZT-7* whereas Cavaglieri *et al.* (2005) reported the growth inhibition and *in vitro* suppression of fumonisin B1 production by *Fusarium verticillioides* in presence of *Azotobacter armaniacus* RC2. Mali and Bodhankar (2009) reported the inhibition of *Aspergillus terrus, Alternaria alternata, Aspergillus flavus* and *Fusarium oxysporum* by *Azotobacter chroococcum* isolated from rhizosphere soil of groundnut plants from Sangli district of Western Maharashtra. Similarly, Agarwal and Singh (2002) also showed the antifungal potential of Azotobacter sp. against *F. oxysporum, Rhizoctonia solani* and *Aspergillus sp.* Chauhan *et al.* (2012) also reported the potential of Azotobacter isolates against *Rhizoctonia solani* and *Fusarium oxysporum* in cotton, tomato and guar plants.

In the present study the isolate SR-14 was identified as *Azotobacter chroococcum* and it's morphological and biochemical characteristics are given in Table 2. The effect of temperature fluctuations and salt concentration on growth of Azotobacter chroococcum SR-14 was studied. It was found that SR-14 can grow optimally at 30°C but can tolerate higher temperatures up to 45°C. However, beyond this temperature SR14 showed drastic reduction in its growth. Similarly the isolate tolerated salt concentration optimally till 2 % whereas showed reduced growth in 2.5% NaCl concentration containing medium (Fig.1)

Table 1: Antifungal activity of *Azotobacter* SR-14

Sr. No.	Fungal pathogen	Diameter of zone of inhibition(mm) produced by *Azotobacter SR-14*
1.	*Alternaria sp*	-
2.	*Microsporum canis.*	-
3.	*T.* rubrum.	-
4.	*A. parasiticus*	13
5.	*A. niger*	19
6.	*A. fumigatus*	16
7.	*A. flavus*	15
8.	*F. oxysporum*	15
9.	*F. moniliformis*	24

Table 2: Morphological and biochemical tests for identification of Azotobacter sp.

Test	Result
Grams nature	Negative rods
Colony	Smooth, glistening
Opacity	opaque
Motility	Motile
Presence of Cyst	yes
Pigmentation	Brown black
Nitrate reduction	positive
Catalase	+ve
Starch hydrolysis	+ve
Utilization of	
Rhamnose	-ve
Inositol	-ve
Mannitol	+ve
Glucose	+ve
Sucrose	+ve
Malonate	-ve
Galactose	-ve
Glucoronic acid	-ve
Oxaloacetate	-ve
Sodium glycolate	+ve
Benzoic acid	+ve
Glycerol	-ve

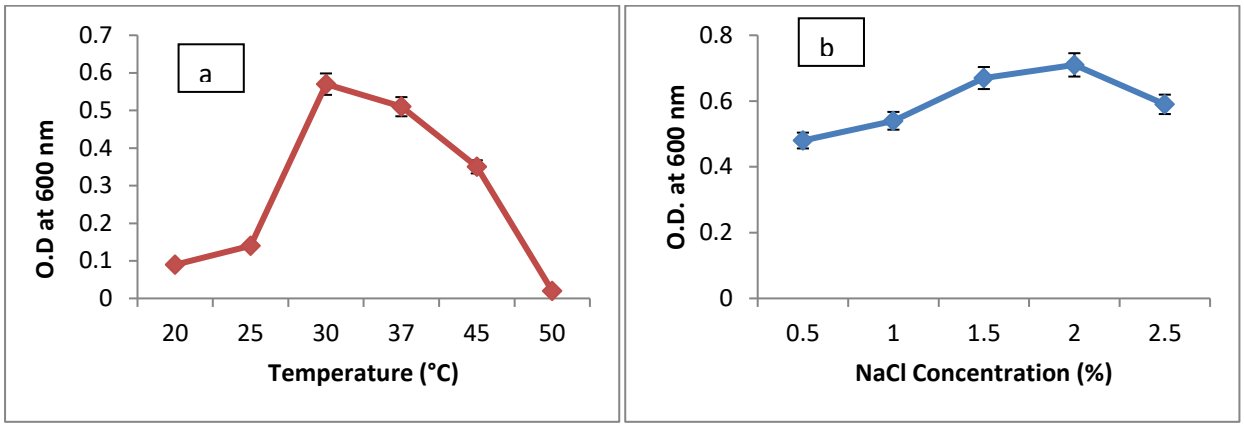

Figure 1: Temperature (a) and Salinity (b) tolerance of Azotobacter chroococcum SR-14

Conclusion:

This study concluded that *A. chroococcum* SR-14 is a potential biocontrol agent with Aa broad spectrum antifungal activity. It can be used to control the potential phytopathogenic *Fusarium moniliformis* and Aspergillus spp. However, it is important to validate the results further for large-scale application in agricultural fields.

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NANOTECHNOLOGY IN AGRICULTURE: FUTURE OF FARMING SUSTAINABILITY

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Abstract:

Nanotechnology is proving to be one of the most urgent tools in agriculture today, and it is predicted to become a major economic force in the near future. Nanotechnology is being used extensively in agriculture, with specific applications, such as nanofertilizers and nanopesticides, being used to improve crop quality and nutrients levels to increase yields without decontaminating soils, waters, or protecting against insect pests and microbes. It can also be used as sensors to monitor the soil quality of agricultural fields, which can protect agricultural plants. Nanotechnology has tremendous potential for making agriculture more efficient and resourceful by using nanoparticles to improve precision in delivering nutrients to a specific region at a specific time. Nanotechnology would prove a boon for modern agriculture farming by increasing nutrient uptake as well as reduce the use of bulk agrochemicals, making tremendously positive effect on sustainable agriculture.

Keywords: Sustainable Agriculture, Nanotechnology, Nanofertilizer, Nanobiosensor, Nanopesticides.

Introduction:

Nanotechnology is a rapidly growing area of science and technology that is influencing all areas of science and technology, and it is listed among the six key enabling technologies that contribute to sustainable competitiveness and growth in several industries by the European Commission (Pramanik and Pramanik, 2016). A number of technology and industry sectors such as information technology, homeland security, medicine, transportation, energy, food safety, electronics, cosmetics, defense, agriculture and environmental science are being transformed by nanotechnology, which has shown promising potential for sustainable agriculture (Abobatta, 2018; Pandey, 2018; Srilatha 2011). It is the most important and stable sector, because it produces and supplies raw materials for food and feed industries. The limit of natural resources such as production

land, water, soil, as well as the rapid growth of the world's population and the technology needed to make agricultural development economically sustainable, environmentally favourable (Mukhopadhyay, 2014; Prasad *et al.,* 2017; Usman *et al.,* 2020). Nanotechnology can monitor a leading agricultural control process, owing to its miniature size in particular, and many other benefits may follow, such as enhancing food quality and safety, reducing agricultural inputs, enriching the soil's ability to absorb nanoscale nutrients, etc. Agriculture, food, and natural resources are all important issues that must be addressed to ensure sustainability, susceptibility, human health, and a healthy life (Prasad *et al.,* 2017). Sustainable agriculture is the means to implement farming practices that protect ecosystems, the environment, and human health while supplying enough grains, meat, plants, or other agricultural products for social purposes (Tilman *et al.,* 2002; Tilman and Clark, 2014; Pramanik and Pramanik 2016). Sustainable agriculture is a concept, but it must be explored and developed specifically for certain agricultural practices. Sustainable agriculture may vary from agriculture to agriculture locally, nationally, and internationally (Pramanik and Pramanik, 2016). A large proportion of those living in developing countries experience daily food shortages as a result of environmental impacts or political instability, while in the developed world, food supplies are in surplus. For developing countries, the goals are to develop drought and pest resistant crops that also maximize yield (Joseph and Morrison, 2006). Nanoparticles offer considerable scientific appeal as a way to bridge the gap between bulk materials and atomic and molecular structures. Nanotechnology has attracted a lot of attention in the agriculture sector over the last two decades for its numerous applications (Tripathi, 2018; Shang *et al.,* 2019; Chhikara, 2020).

To improve agricultural practices, nanotechnology is implementing various nano-devices, nano-formulations, and nano-ingredients, including nano-herbicides, pesticides, and nano-fertilizers for effective herbicides, pesticides, and weed killers (Pandey, 2018). The development and application of nanosensors in precision agriculture to monitor crop growth, soil conditions, diseases, uses, and penetration of agrochemicals and environmental pollution have also significantly improved human control of soil and plant health, quality control, and safety assurance, which are key to sustainable agriculture and environmental systems (Iavicolia *et al.,* 2017; Shang *et al.,* 2019). Numerous problems in agriculture have recurred in recent decades, not because of lack of space or even investments in technology, but rather because of the regular climatic instability brought about by the worsening of global warming and the intensified deforestation. It is on this basis that the precepts of sustainable agriculture have become important in agricultural research groups (Júnior *et al.,* 2020).

Application of Nanotechnology in Agriculture:

The application of nanomaterials in agriculture has foreseen the reduction of plant protection products, the elimination of nutrient losses in fertilizer, and the improvement of yields through optimized nutrient management. The purpose of applying nanotechnology in agriculture is food, feed, and fiber production, as the world population is expected to grow rapidly, requiring more food while natural resources such as land area, soil fertility, and water are being depleted constantly. Because of limited resources, the cost of growing crops will rise at an alarming rate, and precision agriculture is a better solution to maximise agricultural production and reduce costs (Javad ed., 2020).

Nanobiosensors:

Nanotechnology has provided the agricultural sector with nanosensors that can be used to check crops in the field as well as can be used in precision farming to improve the productivity of agricultural crops with a better management of time, fertilizer, and the environment (Javad ed., 2020). A biosensor is a device that combines a biological recognition element with physical or chemical principles to produce a measurable signal component; biological recognition is achieved via the transducer process, and signal processing is achieved through electronic achievement (Prasad *et al.,* 2017). Various natural and artificial bioreceptors, such as enzymes, dendrimers, thin films, etc., are now being developed and used (Prasad *et al.,* 2017). Nanobiosensors are analytical devices with a minimum measurement dimension of 100 nanometers and are made from nanoparticles, nanotubes, nanowires, or nanocrystals for monitoring plant fragments, soil, and water in the agroecosystem (Marchiol, 2018). Nanobiosensors offer more advanced and improved features than existing analytical sensors and biosensors that combine biological element recognition with chemical or physical principles (Marchiol 2018). and they can be used to ensure the efficient application of fertilizers, pesticides, herbicides, and other treatments (Javad ed., 2020). The use of nanobiosensors for high-resolution crop monitoring could prove a powerful tool for plant science research, as the continuous, real-time measurement of plant metabolites and hormones would enable a deeper understanding and control of plant biosynthetic pathways in ways that are impossible currently (Marchiol, 2018). The nanomaterials such as gold, silver, cobalt NPs, CNT, magnetic NPs, and QDs have been intensively studied for their applications in biosensors which have become a new interdisciplinary frontier between biological detection and material science (Prasad *et al.,* 2017). The nanosensors have recently been combined with a GPS system for real time monitoring of cultivated fields. A network of wireless nanosensors can be incorporated into cultivated fields, which allows users to monitor soil condition and crop growth throughout

the growing season. Precision farming can be best carried out using nanosensors, which aim to boost production by requiring minimal inputs. Information from nanosensors can therefore assist farmers in making better decisions (Panpatte *et al.,* 2016; Joseph and Marrison, 2006).

Nanofertilizers:

Nanofertilizers are nutrient fertilizers composed, in whole or in part, of nanostructured formulation(s) that can be delivered to plants to allow for efficient uptake or slow release of active ingredients (Raliya *et al.,* 2018). The use of nanomaterials in agriculture can improve crop productivity and regulate the supply of nutrients to plants and targeted locations, ensuring the minimal use of agrochemicals. In conventional agriculture, larger amount of fertilizers are required as an excess of fertilizer is either sprinkled on the leaves or applied directly into the soil, which is more than the plant's nutritional requirement (Bose, 2020). The rapid changes to chemical forms that the plants do not absorb, along with runoff, leaching, or atmospheric losses are the biggest trajectories of low nutrient uptake efficiency for nitrogen and phosphorus fertilizers. This excess chemical fertilizer negatively affects the soil's nutrient equilibrium, and can also lead to contamination of local water supplies as toxic substances are leached into water bodies. It is therefore crucial to create smart fertilizers that are easier for plants to absorb. Nanotechnology is a suitable approach to achieving this objective sustainably and precisely (Raliya *et al.,* 2018). The nanofertilizers reduce the rate of nutrient release compared with conventional fertilizers, while on the other hand, increasing their stability through aggregation or adsorption increases their biological properties without causing any changes in chemical speciation due to pH-dependent phenomena, redox potential, and availability of ligands in the soil (Raliya *et al.,* 2018). There are several reasons why nanofertilizers are more beneficial for sustainable and environmentally friendly crop production. Nanofertilizers enable the absorption and utilization of efficient nutrients without any larger losses and reduce the risk of environmental pollution by reducing nutrients' losses. They have higher diffusion and solubility than conventional synthetic fertilizers, and they deliver nutrients gradually to crop plants in a controlled manner, which is in complete contrast to the spontaneous and rapid release of nutrients from chemical fertilizers (Thavaseelan and Priyadarshana, 2021). Ammonium charged zeolites, which can increase the solubility of phosphate minerals, can improve phosphorus availability and uptake by crops. Graphene oxide films, a carbon-based nanomaterial, can prolong potassium nitrate release, extending the time of action and limiting losses by leaching (Bose, 2020). Nanofertilizers have the added advantage of allowing selection of the nutrients required for

a crop. Nanoparticles improve agriculture by removing biotic and abiotic stresses by balancing the elements. However, the intensive use of nanofertilizers can have some disadvantages and limitations that require particular attention (Júnior *et al.,* 2020).

Nanopesticides:

Pesticides are widely used in agriculture to improve crop yield and efficiency. Urea is the most widely used fertilizer for crop production and is a source of nitrate, nitrite, and urease, which are ubiquitous contaminants in water that cause eutrophication and have significant environmental effects. Pesticides can be classified by the type of target organism they target, such as insecticides, herbicides, fungicides, nematicides, rodenticides, and miticides (Ware, 2000). Nanopesticides are used to protect plants using nanotechnology, which provides new methods to design active ingredients in nanoscale dimensions, in addition to their formulation and delivery (Benelli *et al.,* 2017). Encapsulation is a very common approach in nanotechnology, which involves entangling one substance within another substance, resulting in particles of a few nm to a few mm in diameter. Encapsulation is used to secure nutrients in the soil for a long time or to prevent them from reacting with other soil components, resulting in undesirable effects (Bratovcic *et al.,* 2019). For the production of nano bio-pesticides, biological compounds with pesticidal properties are used as capping and reducing agents and blended with silver salt. They must be safe for non-target organisms as well as the environment, be non-toxic, not accumulate in the food chain, not affect the quality of food, fragrance, texture, and flavor, and be easily available for application. Because of their large surface area, nanoparticles can form strong bonds with other compounds quickly and circulate easily in the lepidopteran insect's system. Nanoparticles made of silver, nanostructured alumina, aluminum oxide, zinc oxide, and titanium oxide have insecticidal properties.

Metal based nanoparticles:

The interaction between plants and nanoparticles could be chemical in nature, involving membrane transport, active oxygen species formation, lipid peroxidation, ion-cell disorder, and oxidative-breakage. In seed germination, growth, and seed vigor, nanoparticles have a considerable influence, and they are remarkably effective at increasing plant growth and germination (Pandey, 2018). Silver nanoparticles (AgNPs) that have a high surface area and high percentage of surface atoms, have a higher antimicrobial potential than bulk silver. In addition, AgNPs are widely recognized for their antioxidant, antifungal, antiviral, and anti-inflammatory properties. It is stressed that the use of AgNPs in agriculture is predominantly theoretical, but in the near future, researchers will come up with diverse applications of silver nanoparticles. DNA-directed silver NPs were grown on

graphene oxide and tested their antibacterial activity against xanthomonas perforans, a causative agent of bacterial spot in tomato plants (Polash *et al.,* 2017). AgNPs were found to be effective against plant pathogenic bacteria. The effects of nano-silver on pests are non-toxic, safe, and effective. Zinc oxide NPs have potential to boost the yield and growth of food crops. These zinc oxide nanoparticles were also effective in stimulating peanut stem and root growth (Sabir *et al.,* 2014). Copper nanoparticles (CuNPs) have gained worldwide attention due to their broad-spectrum antimicrobial activity. Copper is one of the most important micronutrients that plays a role in the growth and development of plants. Agriculture can use CuNP-based fertilizer and herbicide. CuNPs are cost-effective for use in a variety of agricultural applications (Rai *et al.,* 2018). Titanium dioxide nanoparticle enhanced seed germination and promoted radicle and growth of canola seedlings. Titanium dioxide nanoparticle regulates enzymes activity involved in nitrogen metabolisms (Chaudhary and Singh, 2020).

Conclusion:

Nanotechnology is an environmentally friendly and cost-effective technology in agriculture that can provide many benefits by reducing fertilizer waste, improving plant protection practices, and providing real solutions to agricultural problems such as improved crop varieties, plant protection, detection of diseases, and monitoring of plant growth. Nanotechnology has found many uses in agricultural applications, such as nanofertilisers, nanopesticides, nanobiosensors, and environmental remediation agents. Applications of nanotechnology have incredible potential to meet future agricultural challenges, such as food security. In light of the tremendous challenges we face, mainly due to a rising global population and climate change, the application of nanotechnologies as well as the introduction of nanomaterials in agriculture have made great contributions to solving the sustainability problem. However, understanding nanomaterials' fate and environmental effects remains a major challenge in agricultural and environmental sciences. Despite the fact that a great deal of information is available about each nanomaterial, the toxicity of many of these compounds remains indefinable, thus the application of these materials is limited by the lack of knowledge of risk assessments and health effects. In order to develop efficient, multifunctional, stable, cost-effective, and environment-friendly nanomaterials, collaboration between institutes is essential.

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AN OVERVIEW ON FRESHWATER BLACK CRAB *BARYTELPHUSA CUNICULARIS*: NUTRITIONAL ASPECTS ON FOOD SECURITY

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Abstract:

Introduction: Human consumption on freshwater crab has increased day by day in world wide. As a whole, seafood products, freshwater fishery products like fishes, prawns, and crustaceans are commonly used. The nutritive value of crustacean's meat has been extensively investigated in various parts of country. Chemical composition like proteins, fats, carbohydrates, minerals, vitamins etc. has great importance due to their nutritive role in human health. Freshwater crab is well known for having antioxidants, which reduces risk of chronic diseases including cancer and heart diseases. Crab meat consists of Omega 3 fatty acids, selenium, riboflavin, copper and phosphate that are useful for storage and absorption of iron.

Materials and Methods: In the present review the crab byproducts useful in regular diet of fisher tribes are highlighted. Our aim was to review on how to increase the population of black crab species through captive breeding and to determine the chemical composition and their current applications.

Results: The suggested captive breeding technique is one successful step towards captive rearing as backyard crab hatchery as nutritional security, instead of time spending hunting of this crab resulting in to its ecological vulnerability.

Keywords: *Barytelphusa cunicularis,* captive breeding, by-products, Nutrition.

Introduction:

Crab (Crustaceans) is one of the ancient aqua-food for mankind next to fish, prawns and lobsters. From 6,700 species of crabs distributed globally 1,306 species found in freshwater (Darren, *et, al.* 2008). Crabs mostly inhibit in rivers where they prefer stagnant, muddy water with vegetation and secured hiding places. *Barytelphusa cunicularis* (Westwood, 1836) is black colored crab of average maximum body w eight 500-800 gm. The Nomedic tribe (NT) Bhoi, Koli, having inland fishers at their livelihood depend on *Barytelphusa cunicularis* collected from natural habitats. *Barytelphusa cunicularis* a

nutrition rich source of proteins and calcium. Micronutrients were also detected in this crab species including vitamin A and vitamin B complex, selenium and trace elements. Tribal use this in their routine diet in all seasons as nutraceutical to cure cold, cough, erectile deficiency, joint pain, vision problems, skeletal disorders etc. Formal structured and semi structured interview of fisher tribes in Godavari river basin in parts of Maharashtra were used as a tool to collect data, for increasing demand in fish markets results in indiscriminate hunting of this crab species. Ultimate results into decreasing population of this crab from natural sources. To conserve this species a backyard concrete tank model hatchery cum maintenance pond was designed to investigate the culture possibilities of this species. The culture technology is planned to transfer to the tribes.

Table 1: The different types of crab by-products generated with their valuable components for potential areas of application

Crab by-products	Functional ingredients	Suggested application areas	References
Crab Shell (carapace)	Chitin, Chitosan	Agriculture, anti-microbial property	Athira, *et al.*, 2017
Crab meat	Lipids	Food Industries, oil	Ghorpade, 2018, Moghal *et al.,* 2017.
Hepatopancras	Lipids	Food,	Sayyed, 2017
Hemolymph	Protein	Biological Processes	Sakhare & Kamble, 2014; Martin (2010)
Crab curry	Na+, K+ Zinc, Selenium	For fever,	Chavan *et al.,* 2016

The roll of crab fishery in food security:

Crab as food is acceptable in local markets of Nanded after fish. Crabs are eaten in regular diet of tribal people, but mostly preference of 'crab curry' given to the fever patient in this area. According to local market survey by (Padghane *et al,* 2016), there is no any crab culture practices in Marathwada region. Fisherman collects crab from Godavari river basin and its tributaries. Major hunting of crab takes place October, November and December, because more crab population is found and it attain full of meat in this months.

Crab culture is promising Solution to conserver population and food security:

There are two species mostly found in Nanded region of Maharashtra, *Barytelphusa cunicularis* and *B guerini.* In local market, people purchase black crab for consumption. For captive breeding of this species, small scale pond construction has been done in University campus. Crab purchase from local markets as well as brought from river. Appropriate maintenance has been taken place.

Crab processing by-products containing several valuable components:

Protein:

Protein percentage and body meat of freshwater crabs was studied by (Manhas, *et.al.*2013), maximum in body meat (62.16 ± 0.30 followed by claw 57.39 ±0.35 %. Similar study has been carried out by (Islam *et.al.*2017) claw meat 49.06± 1.01 while minimum in body meat 35.01±1.03 g/100g. It is major concentration in body.

Lipid:

Lipids are major source of energy in marine as well as freshwater crustacean for their essential processes like growth, molting and reproduction.

Hepatopancreas as a source of fatty acids:

Hepatopancreas of crustaceans is generally regarded as a major lipid storage organ. The importance of crabs as a source of protein rich food.

Chitin as fertilizer:

Chitin from crabs exoskeleton used as fertilizers for plant growth as promoter (Surva and Giri, 2014). Also, Chitin is reported to be active against viruses, bacteria and other pests.

Conclusion:

In this area, *Barytelphusa cunicularis* was highly commercialized and consumed. But, in our state these crabs utilization is limited due to lack of knowledge. The present review has shown that crab meat is good source of protein and minerals especially Calcium, Potassium and Sodium. This study reveals that the crab is ideal diet food and consumption of crab may help to prevent nutrition deficiency in the future.

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